WORKSHOP

STATE OF CALIFORNIA

AIR RESOURCES BOARD

OPPORTUNITIES FOR ADDITIONAL GHG REDUCTIONS

FROM TRANSPORTATION FUELS

CALEPA HEADQUARTERS

COASTAL HEARING ROOM

SECOND FLOOR

1001 I STREET

SACRAMENTO, CALIFORNIA

MONDAY, AUGUST 20, 2018

10:00 A.M.

JAMES F. PETERS, CSR
CERTIFIED SHORTHAND REPORTER
LICENSE NUMBER 10063

A P P E A R A N C E S

BOARD MEMBERS:

Professor Dan Sperling, Ph.D.

STAFF:

Ms. Emily Wimberger, Chief Economist

Ms. Joshua Cunningham, Branch Chief, ECARS Advanced Clean Cars Branch

Ms. Rajinder Sahota, Assistant Division Chief, Industrial Strategies Division

PANEL PRESENTERS:

Dr. Roger Aines, Lawrence Livermore National Laboratory

Dr. Severin Borenstein, University of California, Berkeley

Mr. Peter Erickson, Stockholm Environment Institute

Mr. Siva Gunda, California Energy Commission

Dr. Christopher Knittel, Massachusetts Institute of Technology

Dr. Ashley Langer, University of Arizona

Mr. Jason Marshal, California Department of Conservation

Ms. Saharnaz Mirzazad, Strategic Growth Council

Ms. Amy Myers Jaffe, Council on Foreign Relations

Ms. Hannah Pitt, Rhodium Group

ALSO PRESENT:

Mr. Nathan Alonzo, Fresno Chamber of Commerce

Ms. Kaelyn De Leon, Greater Bakersfield Chamber of Commerce

A P P E A R A N C E S C O N T I N U E D

ALSO PRESENT:

Ms. Martha Dina Argüello, Physicians for Social Responsibility, Standing Together Against Neighborhood Drilling in LA.

Ms. Lizette Hernandez, Physicians for Social Responsibility, L.A.

Mr. Bill Magavern, Coalition for Clean Air

Mr. Richard Markuson, Associated Builders and Contractors, Central California Chapter

Ms. Amanda Moneta Ninia, Kern Citizens for Energy

Mr. Colin Murphy, NexGen California

Ms. Kathy Reheis-Boyd, Western States Petroleum Association

Mr. Michael Saragosa, Central Valley Latino Mayors and Elected Officials Coalition

Ms. Shannon Sedgwick, Los Angeles Economic Development Corporation(LAEDC) Institute for Applied Economics

Mr. Michael Turnipseed, Kern County Taxpayers Association

Mr. David Weiskopf, NextGen California

I N D E X

I N D E X C O N T I N U E D

P R O C E E D I N G S

CHIEF ECONOMIST WIMBERGER: Okay. Let's go ahead and get started. Thank you, everyone, for coming. Hopefully, this will be a very interesting day of discussion on a very interesting topic.

First, let's go through some logistics. In the event of a fire, please take it seriously, exit the room, go downstairs, and outside. The meeting spot is across the street at Cesar Chavez Park. Please wait there for the all-clear.

There are bathrooms out the door and to the left, and there is also a cafeteria downstairs.

(Thereupon an overhead presentation was presented as follows.)

CHIEF ECONOMIST WIMBERGER: Okay. All the materials and the link to the webcast for today's workshop can be found at the first link shown on the slide. We will be accepting informal public comments, the link to which is found at the first address. And we are accepting informal public comments through this Friday, August 24th, at 5 p.m. We're also accepting questions and comments today via the web. Please email the email address listed here.

I would also like to note that a rulemaking proceeding to amend the Low Carbon Fuel Standard is

currently ongoing. And a public comment period on proposed modifications to the proposed amendments is currently open. Please direct any written comments on those proposed modifications to the LCFS rulemaking public comment docket.

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CHIEF ECONOMIST WIMBERGER: Now, for Today's schedule. After a brief introduction, I'll be handing the reins over to Rajinder Sahota of the Air Resources Board to provide some framing for the discussion today in the context of the 2017 scoping plan update that was just passed in December.

The modeling for that update shows that achieving the 2030 GHG target will reduce petroleum demand in the state by an estimated 45 percent. Then we'll go into some more details about policies and actions that are reducing GHG emissions in the transportation sector in California, and with a focus on petroleum production in the state and consumption.

Then that will take us to about 11:30 and a lunch break. The afternoon, we will reconvene and we will have two technical panels. The bios of the panelists are on the back table. The first panel will focus on additional GHG reduction opportunities from reductions in petroleum consumption. And the second will focus on examining

options to limit production of petroleum for additional greenhouse gas reductions. We will be taking written public questions for the panelists at that time.

There will also be an open comment period following the panels and a wrap-up and we can discuss some next steps.

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CHIEF ECONOMIST WIMBERGER: So to provide a little bit of background for today's workshop, the transportation sector, including upstream emissions, comprises half of California's greenhouse gas emissions. Emissions from the sector, specifically from gasoline used on on-road vehicles have increased. While we remain on track to achieve our 2030 target, and our 2016 inventory shows that we achieved the 2020 greenhouse gas target four years early. Improving air quality for the state's most impacted communities requires that we remain very vigilant.

This workshop is part of CARB's commitment to ensure that we are achieving greenhouse gas reductions, and to take a closer look when sector emission trajectories increase over time.

To that end, we will hear today about GHG trends in the transportation sector, plans for how we will achieve our 2030 greenhouse gas target and beyond, and

look more at the consumption and production trends in California.

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CHIEF ECONOMIST WIMBERGER: So first, I'd like to kick it over to Rajinder Sahota to give a bit more background.

INDUSTRIAL STRATEGIES ASSISTANT DIVISION CHIEF SAHOTA: Thank you, Emily, and good morning, everybody.

Most of you may know me as the person that helped shepherd the scoping plan that was adopted in December 2017. And some of these slides will look familiar. But we felt it was important to provide a framework, an overview, of how transportation emissions fit within the statewide emissions inventory, and all of the various programs that we have in our portfolio.

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INDUSTRIAL STRATEGIES ASSISTANT DIVISION CHIEF SAHOTA: While I will give a high level overview, Joshua Cunningham, to my left, will give a more detailed review of the ARB policies.

So when we look about -- when we look at the California greenhouse gas reduction target, this slide shows that the 2020 target -- you know, we only had a little bit to reduce, and that's that upper darker portion of the bar chart to get to the 2020 target. When we look

at 2030, we have a 40 percent reduction from 1990 levels, and for 2050 it's an 80 percent reduction. So between now and 2030, we are looking at an accelerated rate of greenhouse gas reductions to achieve our 2030 target.

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INDUSTRIAL STRATEGIES ASSISTANT DIVISION CHIEF SAHOTA: Looking at this graph, we can see the progress to date in reducing greenhouse gases in the state. The green line at the top is the overall emissions inventory. And it does show in 2016 that we were below the target. And that's a really good thing for the state. What we need to do is make sure that we continue this trend, and that any progress we make between now and 2020 is actually going to be beneficial and helpful as we think about the accelerated rate of reductions needed post-2020.

The blue line shows the per capita GHG emissions. And those have also continued to decline over the last 10 years. So it's important to remember that we have made significant progress in reducing greenhouse gases in the state of California.

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INDUSTRIAL STRATEGIES ASSISTANT DIVISION CHIEF SAHOTA: This slide shows how the economy has grown over time. So since 2006 when AB 32 was signed, we've had a suite of policies that have been in place to help reduce

greenhouse gases in the state. What you see is that we've had a sustained period of economic growth. We do see that little kink in 2008, which was the Great Recession. But overall, the economy has continued to increase for the state of California.

The bluish line towards the bottom is the CO2 per million GDP dollars. So the carbon -- the economic state of California is becoming less carbon intensive over time, as well as the economy continuing to grow. So when you put all this together, you have a really good story. Emissions have come down per capita overall for the state, the economy has grown, and the amount of carbon per GDP in million dollars has also continued to be getting cleaner over time.

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INDUSTRIAL STRATEGIES ASSISTANT DIVISION CHIEF SAHOTA: When we think about greenhouse gases in the state, we think about policies to reduce those emissions. It's important to have an understanding of what sources contribute to greenhouse gases in the state.

What you see here, this is the 2016 inventory. You see the transportation sector, which is really the tailpipe emissions in the state, is 39 percent of the state's overall green gas inventory. The industrial portion, which is about 21 percent, half of that is oil

and extraction and refining.

So when you add those two pieces together, the transportation sector from extraction production and combustion in the state contributes to about 50 percent of the state's overall greenhouse gas inventory. And so addressing these emissions is key to helping to make sure we hit our 2030 and 2050 targets.

I would also note that the inventory that you see in the pie chart does not include natural and working lands, as those are not inside the scope for AB 32, but natural and working lands are a big potential for reducing emissions throughout the state as being a carbon sink.

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INDUSTRIAL STRATEGIES ASSISTANT DIVISION CHIEF SAHOTA: The climate change scoping plan that was adopted in December 2017 is a comprehensive strategy to meet our 2030 target. It actually includes a suite of policies. It's not just one policy. And many of these policies build on existing pieces of legislation, or on policies that were enacted from 2006 from the previous scoping plan.

First is the Mobile Source Strategy. It's actually primarily adopted to help the state achieve its federal and state air quality standards. And it will also reduce greenhouse gases in the state.

There's also the Sustainable Action -- Sustainable Freight Action Plan, which looks at goods movement throughout the state and how to reduce emissions from moving goods from -- through ports and through the rest of the state.

We also have SB 375 which is about sustainable community development. And this is about active transportation communities that are more friendly for walking and getting folks out of their vehicles. We have the enhanced Low Carbon Fuel Standard. In the scoping plan, we did indicate that we were looking at a carbon intensity reduction of 18 percent by 2030.

The proposed regulation has a 20 percent. And so through the public comment process and public workshop process, we realized we could do a little bit more on the Low Carbon Fuel Standard than we originally anticipated in the development of the scoping plan.

SB 350 is about increasing renewable energy and energy efficiency. This one is important, because as we think about decarbonizing the electricity sector and we think about zero-emission vehicles, we can start to think about how electricity interacts with the transportation sector as a fuel source for transportation without -- throughout the state.

We also have SB 1383, which is about short

short-lived climate pollutants. And when we think about dairies, we think about biogas and having that biogas available for some of the transportation fleet. And then post-2020 Cap-and-Trade Program, which is due to release a regulatory package in the next couple of weeks with amendments that conform to AB 398.

What's important to realize when looking at the suite of policies is that in some way or aspect, they all interact with the transportation sector. And so there's not just one policy that we're looking at to address transportation emissions, we're looking at all of these in some way to help reduce greenhouse gas emissions in the transportation sector.

And as you think about the pol -- the suite of policies, that 45 percent demand reduction is really -- is really, in part, due to how all of these work together to reduce the demand use for on-road fuels.

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INDUSTRIAL STRATEGIES ASSISTANT DIVISION CHIEF SAHOTA: So when we look at the transportation sector specifically within the scoping plan, in the modeling it was indicated that successful implementation of the scoping plan would est -- would result in an estimated demand for fuel by 45 percent by 2030.

Some of you may remember the Governor's pillars,

and he was asking for a 50 percent reduction. What we ended up with was a 45 percent reduction estimated, as part of the scoping plan modeling.

The greenhouse gas emissions for the sector are reduced by approximately 30 percent from 1990 levels by 2030. And when we think about the cumulative reductions needed from the business-as-usual scenario from 2021 to 2030, it's about 620 million metric tons. And one-third of that is estimated to come from the policies and their efforts to reduce greenhouse gas emissions in the transportation sector.

So it continues to be a big part of our plan to achieve the 2030 target. And all of the policies in place are aimed to actually touch upon the transportation sector, whether directly or indirectly.

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INDUSTRIAL STRATEGIES ASSISTANT DIVISION CHIEF SAHOTA: Another piece that's important to consider is the macroeconomic impacts of the scoping plan. There's always concern that enacting these policies may have a negative impact on the state's economy, or on households, or on jobs. And so when we looked at the scoping plan, we looked at a relative reference scenario in 2030. The economy continues to grow. We will add jobs, so that -- we add about 23.5 million jobs. And personal income will

increase by -- to three trillion -- three -- yeah, three trillion.

So the average growth rate of the state GDP employment and personal income are essentially unchanged relative to the reference scenario. And it's important when we think about the scoping plan to always remember that it's a sweet of cease.

Not only do the emissions policies interact with each other, or the actual requirements for field reduction and technology advancements interact with each other, but also that the cost and savings interact with each other. And when you think about costs for implementing policies, such as LCFS, Cap-and-Trade, Mobile Source Strategy, the 45 percent reduction in demand works to counter that impact on the economy, on employment, and on personal income.

Just to put some context for the numbers. With cap and trade, we did use a very conservative estimate for what the potential prices could be in cap and trade. We used an $84 price in 2018 dollars as an upper bound when we did this modeling. And so we wanted to make sure that we were reflecting a worst-case scenario in terms of costs, and we took a conservative approach. When you look at the table, you see that there's a very negligible change in the California GDP, employment, and personal

income as part of implementation of the full scoping plan.

So that ends my portion of the presentation framing the overall transportation sector and the scoping plan.

I will now turn it over to Joshua Cunningham to speak in more detail about all of the policies that we have.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: Thank you, Rajinder. I'm the Chief of the Advanced Clean Cars Branch at the Air Resources Board, which oversee the light-duty regulatory efforts and EV support programs.

But today, I'm going to provide a high level summary of the transportation initiatives, as Emily and Rajinder note, that we do at the Air Resources Board target at reducing greenhouse gas emission and petroleum reduction.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: Many of you follow individual programs at the Air Board, and we wanted to show you a breadth of what we do as a starting point for today's conversations to ensure that you get a sense of everything that we do to tackle emissions in this sector.

I'll touch upon light-duty and heavy-duty on-road programs, both regulatory and incentive efforts. And then we'll finish with policies on low carbon fuels and petroleum.

As Emily and Rajinder noted, the transportation section comprises, when you look at the full inventory, over 50 percent of the emissions, when you look at both direct emissions from the vehicles in the on-road and off-road sectors, which is about 40 percent of the inventory. And then the upstream emissions from petroleum and gas extraction and refinery operations take that above 50 percent directly attributed to transportation.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: In the 217 scoping plan, it touched upon many elements, but I wanted to highlight a few here that affect how we look at the transportation sector to get the deep greenhouse gas emission reductions and petroleum reductions long term, focusing on whatever everyone experiences on a day-to-day basis. And we need to, of course, promote vibrant communities and landscapes through better planning efforts to improve transportation efficiency and increase mode shift and walking and biking.

Additionally, we need to continue and enable our most effective clean transportation technologies by

focusing on our successful efforts in regulatory and incentive based efforts at the state level. This will help move clean technologies into cars, trucks, buses, and fuels, and expanding them in the market.

We need to continue to coordinate agency efforts, including our partners here today to help present from the State agency level to ensure that we're addressing some of the new transformations that are occurring in the transportation sector, including autonomous technologies, connected ride-hailing technologies, so that we best understand how those are going to affect emission projections in the future, and that we account for those, but enable those technologies to help improve mobility.

We need to improve freight and goods movement efficiency and sustainability to enable California's continued economic growth. And finally, we need to embrace and connect California's high-speed rail to our communities looking forward.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: We can successfully build on some of the progress over the past ten years that has really advanced some of the initial new technologies in energy and transportation sectors. To date, California's policies have created markets for energy efficiency, energy

storage, low-carbon fuels, and renewable powers.

Electric vehicle batteries have declined as a specific example, much more quickly than solar costs and more rapidly than even our staff analysis did in my program a few years ago when we did our rulemaking in 2012, while performance of the technologies have -- has improved more dramatically than we expected.

And the auto industry is -- we're excited to see is embracing this technology and moving it forward with products coming to market.

With all of that, California is home to nearly half of the zero-emission vehicles on the roads in the United States, 40 percent of North American clean fuels investments and the world's -- some of the world's leading providers of these technologies, including electric vehicle manufacturers, and ride sharing services.

The graph on the left shows that we could see projected electric vehicle markets growing faster than we had projected. And so that all provides a background for how we think we need to move forward on new policies to advanced greenhouse gas emission reductions.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: Focusing on light-duty vehicles, which is the core of a lot of what we need to do for the transportation

sector. We have the vehicle regulatory efforts collectively -- oh, thank you, Steve. I'm looking at my wrong slide here.

As outlined in our Mobile Source Strategy, underpinning the scoping plan that Rajinder noted, Air Resources Board has a number of strong programs that already address the light-duty vehicle sector.

So showing here on the slide, we bundle those into three broad categories: Policy that address vehicles, policy that address activities and communities; and then policies that address the fuels.

For vehicle emissions and technologies, we have the advanced clean cars suite of regulations. I'll show a bit more of that on the next slide or so.

Air Resources Board also manages incentive programs, such as the Clean Vehicle Rebate and EV car-sharing efforts to enable the technologies to move out into the markets, and I'll talk about that a bit as well.

On the community and activity level, we expand mobility options, reduce vehicle travel needs through our Senate Bill 375 Sustainable Communities Strategy Program. And we engage with other agencies to ensure that we're improving mobility and transportation options in general.

And finally, the last few slides I'll talk about -- we'll look at some of our Low Carbon Fuel

Standard initiatives that Rajinder highlighted, as well as ZEV fuel infrastructure strategies, which are critical to enable EV operations in our communities.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: So a slide on the program that I oversee, our light-duty vehicle regulatory effort. Advanced Clean Cars Program is our current incarnation of our vehicle requirements for the model years 2017 to 2025. At that point, the stringencies remain in place and for the years after that point.

The program includes three regulatory efforts: Our Low Emission Vehicle III greenhouse gas vehicle programs, which is aligned with national standards; our California specific ZEV regulatory effort; and then our LEV low-emission vehicle criteria emission tailpipe -- fleet average standards.

All three of those encompass critical efforts to improve the efficiency, greenhouse gas emission reductions, and EV technologies. And a few of those are aligned at the national level for one national program.

But this only takes us to 2025, although this particular standard gets us, we estimate, about 35 percent reduction in greenhouse gas emissions by 2050, which is really important at the light-duty vehicle fleet. We know

we need to do more to address Senate Bill 32 and other air quality requirements.

So we're already starting to work on Advanced Clean Cars II, which is our next vehicle regulatory effort, which would start in 2026. And we're anticipating taking a proposal to the Board by 2020 to start looking at policies that go beyond that current program.

Guiding principles that we have been starting to talk to stakeholders about. We want to ensure that we're tackling as much of the real-world emissions as we anticipate beyond just the certification levels. We want to increase the certainty of electric vehicles that we could see from the requirements. We want to get similar -- lower system-wide emissions from the new mobility solutions. So specifically making sure that we're taking account for some of the Transformations happening in the sector.

And we want to do all of that while minimizing costs and maximizing the economy -- the economic growth of the industry.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: To complement the regulatory effort, this particular slide emphasizes the collection of incentives and pilot programs we support and implement, some of which

reach into the heavy-duty applications. In addition to the Clean Vehicle Rebate Project, which most of you are probably familiar with, Air Resources Board also has programs that support low-income households through car scrappage and replacement, and making car-sharing programs more available to a wider number of households.

Included in this slide is also the heavy-duty applications, where we have the hybrid and zero-emission truck and bus voucher initiative providing financial support to roll-out cleaner technologies into a wide range of heavy-duty applications.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: To support light-duty and to a certain amount the heavy-duty applications that are going to electric drive, this slide describes the status of our current EV charging and fueling infrastructure out to 2025.

The first few bullets talk about what we have on the ground today and what we project the current programs will get us by 2025. So we have over 15,000 publicly available EV chargers at varying differently levels of power. We have 35 open retail hydrogen stations and a few more anticipated later this year to build upon the success that we need to move out to 2025 for 100 stations.

But as we start to look to what we need by 2025,

we first need to project what do we think we're going to get from the existing efforts which includes State funding, the SB 350 utility investments and private investments. And we're projecting we'll get slightly more than 100,000 chargers and 100 stations for hydrogen by 2025. And we know that that's not enough.

So we know the Governor has an Executive Order of targets for 250 EV chargers publicly available, and 200 hydrogen stations to support the target of 1.5 million vehicles on the road. That's also a critical milestone to ensure that we're on a path to supporting the growing network of chargers and stations to reach the five million vehicles necessary by 2030.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: The newest initiative we are exploring, which has emerged since the scoping plan was adopted, is to push for electric vehicles and fleets. The governor has asked the Air Resources Board to explore new regulatory actions to accelerate fleet-based electric vehicles in a way that some fleets help expand EV awareness, as well as tackle high mileage applications.

We've been asked to explore new policies for light- and heavy-duty applications and explore a wide range of fleet types as we consider which ones are

appropriate for rules.

So we'll be looking at public and private fleets, fleets that are in new mobility services, large employer fleets, rental fleets, and freight services. And we hope you join us next week. Our workshop on this is August 30th.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: Shifting to heavy-vehicle programs, an overarching effort the Sustainable Freight Strategy, which Rajinder noted earlier. This initiative establishes important milestones, implements regulations and funding approaches, as well as pilot projects for freight operations throughout California.

The 2030 targets and initiatives focus on improving efficiency by over 25 percent, trying to achieve 100,000 vehicles and pieces of equipment by that year, while improving competitiveness and economic growth.

A program specifically around freight is important, given the large amount of goods shipments in and around California, particularly our L.A. based ports, as well as road and freight facility activity near communities, where you can see a large number of emissions that we want to reduce for local public health.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: On the regulatory front for heavy duty specifically, we have a number of efforts that are moving forward building upon our existing heavy-duty vehicle truck requirements. I'm listing three here, which are going to the Board soon. We have improvements to our transit requirements. This new one will be called the Innovative Clean Transit, and will focus buses and vehicle activities in and around the transit facilities.

Advanced Clean Trucks regulatory efforts is focusing on last-mile delivery and local trucks, and zero-emission airport shuttle buses. So this is a specific fleet that we are already moving forward on, alluding to what I was talking about earlier. All of those will be moving towards the Board soon for consideration.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: But knowing how complex the freight and heavy-duty sectors are, we need targeted financial assistance as well to complement the regulatory efforts, similar to what we do in the light-duty vector. This slide has a lot of examples that I'm not going to go through, but I'll just highlight a few.

Zero-emission drayage truck demonstration

projects. Over 25 million to demonstrate pre-commercial drayage applications on specific corridors where we know we have a lot of freight activity and can get high impact new strategies on the road.

Over 80 million to deploy 146 zero-emission heavy-duty vehicles as part of the Truck and Bus Pilot Commercial Deployment Project. And then as part of the hybrid and zero-emission truck voucher program I mentioned earlier, over 45 -- 4,500 vouchers have been issued so far to help build technology in specific applications.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: And finally before I move into some of the fuels comments, in all of our efforts for incentivizing advanced technologies, we strive to be strategic in how the investment leverages long-term market growth.

Many times this means investing in early markets, where we want to get technologies into initial applications that provide a catalyst for broader growth later. One example of this is in transit. For years, we've been trying to push and have pushed EV technologies, both fuel cell and battery electric for buses in communities. Investing in clean buses not only provides localized emission benefits in sensitive communities, but cab be test bed for new technologies later to use in

larger freight applications.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: A few slides on the Low Carbon Fuel Standard. This policy was adopted in 2009 to -- with a requirement of reducing the carbon intensity of the fuels by 10 percent by 2020 relative to the 2010 baseline. The policy has been adopt -- re-adopted and improved upon since then. And this year, as Rajinder noted, there's an open rulemaking in front of the Board for extending the program out to 2030.

The Low Carbon Fuel Standard is one of the key AB 32 measures designed to reduce greenhouse gas emissions for fuels in California, but is also significant of our different -- additional benefits. It transforms and diversifies the fuel pool in California beyond petroleum, and also provides air quality benefits throughout the state of California at fuels facilities.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: The Low Carbon Fuel Standard has a couple of key requirements. It sets annual carbon intensity standards, which decrease over time for gasoline, diesel, and the fuels that replace them. The carbon intensity is expressed in grams of carbon dioxide equivalent per

megajoule of energy produce -- provided by that fuel. And it takes into account the emissions associated with the steps for producing, transporting, and consuming the fuel, also known as the complete lifecycle of that fuel product provided to the market.

The providers of the petroleum are the regulated parties. And providers of the low-carbon intensity fuels generate credits, and those credits are bought and sold for compliance purposes that allow flexibility for bringing new fuels to the market.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: In summary, the Low Carbon Fuel Standard is working as design and intended. Regulated parties in the aggregate have overcomplied with the Low Carbon Fuel Standards. We've achieved over three and a half percent reduction in the CI, and banking almost 10 million excess credits as -- at the end of 2017.

Low carbon diesel substitutes. As a specific example, some of the fuel innovations that are occurring now make up over 15 percent of the energy used in heavy-duty vehicles in California by the year 2016, and is growing from there.

The program is well positioned to be a critical part of the portfolio of California's greenhouse gas

reduction measures by 2030. Although implementation of the Low Carbon Fuel Standard has gone well, there are opportunities to improve the regulation. Much of that is now being presented to the Board this year in the rulemaking.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: California's Cap-and-Trade Program has an all-inclusive approach to transportation emissions. Some of this was pointed upon by Rajinder. In addition to the in-state processing and extraction facilities for direct emissions from the fuel development in California, the Cap-and-Trade Program also includes the emissions associated at the tailpipe and the direct combustion of the fuels in mobile source applications, including gasoline, diesel, propane, and natural gas.

The regulated entities must reduce on-site emissions, supply carbon fuels, and/or purchase compliance credits for GHG emission reductions.

The Cap-and-Trade Program creates incentives to invest in cleaner fuels and use for energy efficiency more broadly.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: And finally, moving to one specific area of

the fuels sectors in California. Direct regulation of methane emissions from oil and gas facilities is also occurring in our state, and provides an important reduction of high global-warming pollutants with methane, providing -- reducing methane is a high global warming pollutant, and it's critical to tackle that.

The direct regulations focus on in-state fugitive and vented emissions at the facilities, and cover -- facilities include oil and gas production, natural gas gathering and boosting stations, and underground storage.

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ECARS ADVANCED CLEAN CARS BRANCH CHIEF CUNNINGHAM: And finally, this particular sector is important to focus on, particularly given that it represents over 40 percent of the methane reductions -- these regulations will address over 40 percent of the emissions from methane from this sector. And we wanted to ensure that we're tackling one more area of the greenhouse gas inventory for California.

Okay. With that, I believe that is my last slide. That should wrap-up our summary of the transportation initiatives.

CHIEF ECONOMIST WIMBERGER: Now, we're going to hear from the California Energy Commission.

(Thereupon an overhead presentation was

presented as follows.)

MR. GUNDA: Thank you. Good morning, everyone. Thank you to the Air Resources Board for inviting the Energy Commission to speak at this important workshop.

I'm Siva Gunda. I'm the Manager of the Demand Analysis Office within the Energy Assessments Division at the Energy Commission. And the Assessments Division does trend analysis and future casting of both supply- and demand-side requirements.

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MR. GUNDA: My presentation I'm going to try and cover three broad topics briefly. The crude oil production trends in California historically, as well as the California sources for refining. I'm going to move into the transportation fuel trends, the consumption trends in California, both gasoline and diesel. And then I'm going to end with improving efficiency -- that intersection between improve efficiency and what it does to the consumption, along with the rise of EVs.

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MR. GUNDA: With that, the crude oil trends and sources section.

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MR. GUNDA: This is a pretty packed-up graph here. So just to kind of unpack it slowly. So we're

looking at a slide here that shows the historic trends of California and the U.S. production of crude oil between 1981 and 2018. That's about four decades.

So as you see, one of the obvious things there, the blue line continuously trends down, since the -- since the beginning of this plot here in 1981. And that's California along with the outer continental shelf just the Pacific region.

So it starts about a million barrels a day in 1981, and then it's about a little under half a million barrels a day now in 2018. And that's about a 50 percent reduction over the last four decades.

The upper red line there is the U.S. Crude oil production minus California. And as you see it, up until 2007, the trend is kind of similar to California. It kind of goes down. But in 2007, you had the historically low point unrelated to the hurricanes, about 4.2 million barrels per day. And since then, if you compare that with California, we've kind of seen this complete opposite.

And in the last 10 years, in the last decade or so, the U.S. production as a whole has gone up by 135 percent. And much of that can be attributed to three things: The overall -- the development of the shale oil or the tight oil in the last decade; it's also continuous improvement of the drilling equipment and the efficiencies

there; and also a dramatic increase in the hydraulic fracturing.

So between those three aspects, the overall production in California -- overall production in the U.S. has gone up as California has gone down.

So California has also -- also has shale oil available. But because of the kind of formations we have, the geology in California, it's pretty hard to recover that in a cost-effective manner. And so the geological complexities in both California and Alaska kind of makes it hard to recover shale oil from these two states.

Apart from that, even though the initial outlook for the shale oil in California was pretty huge, since then, there have been a bunch of downward revisions, upward of 90 percent, downward revision about the volume of technically recoverable oil.

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MR. GUNDA: So to just kind of unpack the overall crude oil production a little bit more by states here, we're just now looking at the time period between January 2010 and March of 2018. As you see here, we're just looking at the bars of just the gains between those time periods. So the highest gain has been in Texas, about three million barrels a day. And then -- sorry, three mill barrels a day. And then following with that is North

Dakota about a million barrels a day, and New Mexico is about half a million barrels day.

To just kind put that in context, the overall production in California is about the gain that New Mexico has gotten over the last eight years.

It's also the reduction in California and Alaska is also because we recovered a lot of oil from conventional oil fields, which are much older, and the overall production has slowed down.

The top line up there just kind of calls out, you know, we've recovered about 10.4 million barrels per day production in 2018, which is the highest.

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MR. GUNDA: Now, that kind of moving on from the production side of crude oil to actually refining, this slide kind of shows the California refineries and their oil sources between -- over the last four decades. As you see here, the overall foreign receipts for refining has gone up. One of the things that you'll see in this graph is the overall refining capacity in California has more or less stayed even between 600 and 700 millions -- million barrels a year.

So one of the things that's important to note here is as Alaska has gone down -- the amount of production in Alaska has gone down, and because we can't

cost effectively import oil into California from other states, our dependency on more cost effective foreign oil has increased.

So the continued decline of both California and Alaska crude oil production compelled the California refineries -- refiners to offset the loss using the foreign receipts.

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MR. GUNDA: So now unpacking that a little further, just the dependence on the foreign sources here. So as you see the orange slice is Alaska, which kind of continues to decline over the period shown here, which is the last 30 years or so. The highest importer into California has been Saudi Arabia standing at about 28.5 percent, followed by Ecuador that is about 20 percent, then followed by Colombia which is about 14 percent.

The cost -- the geographical closeness of Colombia with California makes it cost effective in terms of imports. And this is an important thing to note there.

So nearly 69 percent of oil processed in California refineries during 2017 was delivered via marine vehicles -- vessels. That's an important point. And so the -- as we -- what we're seeing here is the waterborne receipts are continuing to grow, and the diversity of the oil also is continuing to grow.

It's important to note that a typical process is -- even though the foreign sources are pretty broad and diverse, typically they're all mixed together before they're refined to keep the consistency kind of close.

And even though -- the second point here is even though we've been seeing year-to-year changes in both the sulfur content as well as the density in oil, overall the it changes have been pretty modest.

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MR. GUNDA: Just to kind of focus here a little bit on the Canadian crude, I'm going to go back to the Canada slice there. If you see the Canada slice, it's pretty constant. It's a very small sliver. It stands about 3.44 percent coming into California.

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MR. GUNDA: Once you kind of unpack that a little bit, the dependence on Canadian crude oil, there's a big difference between the crude oil -- dependence on Canadian oil by the U.S. as whole and California. As you see over the last 10 years or so, the crude oil from Canada has kind of grown a lot in the U.S. from about 20 percent to 40 percent. But in Northern California use of it or California use of it kind of stayed about five percent or under.

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MR. GUNDA: Now, kind of moving into the transportation fuel trends.

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MR. GUNDA: So just looking at here, there's kind of two plots in here. One is just kind of looking at the overall gasoline usage in California. It's pretty obvious there as the economy recovered over the last ten years -- over the last eight years or so, the gasoline consumption has also increased with that.

So the highest level since 2007 was about 15 billion gallons in 2017. But one of the things that you can see there is the overall trend, kind of plateauing. And some of our forecasts for the future show that there will be a steady decline in gasoline consumption, because of the increase in the alternate vehicles as well as fuel economy standards.

In the upper-left corner, the graph shows the unemployment trend, which went from 12 percent all the way down to five.

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MR. GUNDA: This is just kind of showing the gasoline consumption, but also the percent of renewable gasoline in it. So by law, we cannot increase in California more than 10 percent of ethanol gasoline. So that's an important point to remember there. But the

overall renewable content in the average concentration by volume has been increasing. And it's about 10.1 percent. And as we move forward with the increase in E85 usage and flex-fuel vehicles, that might go up as well. So California sales of E85 reached 23.9 million gallons in 2017, which is the highest level to date.

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MR. GUNDA: Moving on to diesel. Diesel is a -- as you see, the overall consumption has been going up. But as shown in the orange and red kind of blocks there, the renewable content in the diesel has also been steadily growing up. And we've attained about a 13.4 percent by volume average concentration in 2017. And it's important to note that as Joshua was pointing out with the LCFS requirements, the increase in the renewable diesel is a way to make sure that the LCF standards are met.

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MR. GUNDA: With that, I will move on into my final section, which is just closing off the improvements in efficiency and the rise of EVs, and how that does impact the overall gasoline usage.

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MR. GUNDA: This is just kind of showing the same graph, the gasoline usage in California over the last eight years, but now we're looking at it per licensed

driver. So it's interesting to see that since 2010, even though overall gasoline usage in California has increased, the gasoline usage per licensed driver has actually gone down.

And to the left upper corner, you see the overall increase in the ZEV vehicles at the transitional ZEV vehicles. As of Q1 2018, the total PHEVs in the market are 187,000, BEVs are at about 205,000, and fuel cell vehicles are about four and a half thousand, bringing the total to about 400,000 vehicles -- alternative vehicles on the market.

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MR. GUNDA: This is just to kind of compare between the California trends and the U.S. trends. If you compare the U.S. per licensed driver versus California over the same time period, you will see that the overall U.S. per licensed driver has been going up. And much of this can be attributed to a higher preference for less fuel efficient light trucks outside of California.

That's something that we also see in our own survey, which we do on consumer preferences. The overall -- the preference for the light trucks has been going up, even in California, but not as drastically as the rest of -- rest of the country.

So this is the last slide I have here. Just kind

of showing the trends. As of our forecast, which we don't have here, we do see positive trends in meeting the five million vehicle goal by 2030.

No problem.

I just want to call attention to Gordon Schremp who is in the audience here, who is our transportation fuels expert. Thanks for his contribution. And if you have any technical questions, he's the person. We also included a contact here, Sudhakar, who is our EV expert for any data you might be interested in on the data we presented on this.

Thank you.

CHIEF ECONOMIST WIMBERGER: Thank you very much. We're now going to hear from the Department of Conservation.

(Thereupon an overhead presentation was presented as follows.)

MR. MARSHALL: Good morning. I'm Jason Marshall with the Department of Conservation. I'm the Chief Deputy Director over there. Within the Department, if you did not know, is the Division of Oil Gas and Geothermal Resources. Bill Bartling is their Chief Deputy. He was significantly involved in this presentation. Asked me to make it. He's presently indisposed at some place in Lassen County.

I envy him.

Here at the Department, we're predominantly a regulatory body. We do know, by exposure, quite a bit about oil and gas operations. I'm going to talk a little bit about demand and -- excuse me, about supply a little bit today here, based upon our observations.

But a lot of what I'm going to talk about, I'll be skipping forward quickly, because it turns out much of the prior presentation you'll see similar slides.

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MR. MARSHALL: This one for instance.

(Laughter.)

MR. MARSHALL: In 1982, more than half of -- half the oil consumed in California was produced in California. That's not too long ago. We started to see declines in around '85, '86. And it's a line that we'll talk about a lot in the next couple of slides.

Alaskan crude, as you can see, was making up the difference. But that has fallen off as those -- Prudhoe Bay sources have started to dry up. More recently, we have seen new discoveries there in Pigot, Willow, and Smith Bay. Those may in ten years make the Alaska component creep back up. But that's ten years out, and we're looking at the immediate term more for the foreign slide, picking up the gap as California's production

falls.

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MR. MARSHALL: Here, similar lines. The top total -- total refined crude, and then the bottom, the California contribution. We've overlaid the price. And this is a -- it's a theme we're going to come back as well. The price of oil does not, in California, seem to drive either the production or the refining. The doesn't appear to be a very strong correlation there.

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MR. MARSHALL: Here, taking a look at a little bit longer term trend. You see back in 1985, parallel lines. As this is -- take a step back. What you're looking at is the percent growth from prior year. So anything above that red line means that in say production or in refining, things were going up.

As we dropped below that red line, we're in declining. These two lines the production and the refining in California were roughly parallel through most of this period with the California production starting to declining there again, '85, '86, and staying in a decline mode, negative growth out through today.

Meanwhile, the refining stays relatively flat, until about 2015 where we start to see now use -- refining and use. So this is also importing of refined product

turning up, and yet California production taking a more steep drop down starting in 2014.

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MR. MARSHALL: It's not always the case that price doesn't seem to matter. In places where they have oil -- more oil to discover and more oil to produce, such as Texas, the green bars and the green line, you can see that there's a correlation there. Price is up and production is growing. In Texas there, for the first couple of years through 2014, price tarts to drop off, production starts to flag. But then as price starts to recover a little bit in 2016, production comes back up.

You see similar -- similar trends for both North Dakota and then decreasingly in New Mexico and Oklahoma. If you look close, you can see that there's a little bit of a hump there in the middle just like the Texas line. California's stays flat.

So again, the point we would want to make here is that where you have oil is where it's going to be price sensitive. We would note that in some places, Texas, New Mexico, their operating costs have been aggressively managed. And operators have done things such as drill wells, but then not complete them, not peforate them, not fracture them, if they have to do that, or some other form of stimulation, just so that they've got a ready inventory

of wells when price recovers.

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MR. MARSHALL: This is the slide when I wish Bill Bartling was here.

The point here really is that operators have finding and development costs that you really need to think about. And when you take a look at this slide, if you can see the numbers, it's a little bit difficult. When the finding and development costs are below the cost or the price of oil, you can expect operators to be, you know, doing at least reasonably well, able to make a dollar.

When you see operators like say Freeport on here, which I think has a operating cost -- forgive me for a second -- Freeport finding and development cost was over $340. Freeport doesn't operate in California anymore and they've divested themselves from oil. They're back in -- doing what their bread and butter is, which is mining.

So there is a way to identify how operators are doing, and how they're likely to be doing as price of oil fluctuates.

Last slide on production.

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MR. MARSHALL: Guess which one is Oak Hills -- pick Lost Hills. The point of this slide is to show you

that we we've got information on all of the oil fields in the state and how their production is doing. Many of them are flat, but the top seven there, they're all in decline, with one maybe notable exception, Cymric, which was declining, and then tarts to come back up a little bit. I'd say overall the Cymric line is overall flat.

Six of these -- woops, excuse me. Two of these fields -- and I'm not talking about carbon intensity in this presentation. Two of these declining seven fields -- top seven fields have a CI that's above 15. The remaining five are below that.

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MR. MARSHALL: Permitting. This is our bread and butter.

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MR. MARSHALL: Our primary job is to permit oil and gas development, construction, and oil field practices to public health, safety, and the environment.

Talk a little bit about that, and give you a brief explanation about the process. Operators first need to get permission to drill from the local land -- local land-use authority. You don't come to DOGGR for a permit without having authority -- authorization already to drill a well there.

Once that's been secured, then DOGGR is issued --

is given a notice of intent to drill. The notice of intent to drill is reviewed. It follows with a permit. And then, and only then, can the operator actually drill the well.

What you're looking at here is the trend of notices of intent, permits issued, and wells drilled compared with the price of oil. As you can see, there's a bit of a correlation on the notices to the price.

The notices track on the approvals, but then also you see the drilling is really the thing that tracks the most to price, not so much the notice of intent or the review process.

So what the means is operators will apply for permits. They just may not exercise that right. I know I said a minute ago that drilling is not price sensitive in California. The -- excuse me, and what I said was the production is not price sensitive in California. The drilling is.

And the key there is that just because you've drilled a new well doesn't mean that we've got an overall increase in production. Many of these wells are just making up for other wells that have had to go idle.

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MR. MARSHALL: Well stimulation also somewhat affected by price. Don't let those first two bars fool

you. Reporting was not required in those years, so that's voluntary reporting of well stimulation.

But you can generally see that well-stimulation practices do track price. We think that in 2015 what we were looking at was a bit of a rush for permits, while we were getting ready to implement new well stimulation regulations.

And then we see this big drop off, which we also attribute, to be perfectly blunt, to some of the some new regulations, and some of the difficulty that it is -- takes now to get a well stim permit. But it's not inconsequential that as the price of oil is down below $70 -- this is a California number that we've observed -- something below $70 per barrel makes well stimulation a little less economically attractive.

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MR. MARSHALL: I mentioned permitting. Where is permitting taking place?

Well, as Jesse James said, why do you rob banks? That's where the money is.

Well, then gas operators seek permits where the oil is. The oil fields are what's in yellow over my shoulder here. Those are all the established oil fields in the state. We have mature oil fields. There aren't a lot of new rank wildcat operations going on in California,

where people are going to find the next big thing. It's been found.

So of the roughly 65,000 permits that have been sought since 2008, the vast majority of them are in these oil fields across the state. One hundred seventy-five of them were outside established oil fields, some of them in neighboring areas, and only 29 of them were drilled and remain active outside those existing oil fields. Those are the green dots up there. And again, you can see that they're approximate in most cases to existing oil fields.

I do need to make sure -- get a reminder in there, DOGGR, Department of Conversation, we don't decide where the oil wells go. We decide how they get constructed.

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MR. MARSHALL: So the next two slides are just a compare and contrast. Here's the notices received. As you can see, most of the notices that we get are for drilling new wells. We get some -- about equal number, a little less reworking. And then abandonment follows that. Abandonment, by the way, is a good thing in oil field parlance, if you didn't know that. I know there are a number of operators here I don't have to explain that to. But those of you who aren't oil operators, abandonment is not leaving it by the side of the road. Abandonment is

fill it with cement, plug it, it's done.

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MR. MARSHALL: Here's our permits issued. And again, it tracks pretty well with what the notices of intent were, the requests. One trend to note, permits to drill and permits to abandon are slightly out of balance. We're growing more wells than we're plugging over time. What does that mean?

It means that some of those wells that have gone idle are staying idle. Many of them staying idle for far too long, and that's a topic that I'll talk about in the next section.

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MR. MARSHALL: So the Division of Oil and Gas has been undergoing, what we call, a renewal since about 2012. A number of regulatory actions we've been taking since that time, and just go through some of these briefly.

Not a lot of them deal with air. Most of that is because most of the rules on air emission are handled by the State and by local air districts. DOGGR standards are generally talking about preventing leaking wells, making sure that valves and flanges are all sealed. We do inspect for the -- for methane leaks, but we're predominantly relying on our partners at ARB and at the

local air districts for that regulation.

However, some of these regulations do have specific air quality components. For instance, the well stimulation rules. One of the challenges, difficulties, hazards of hydraulic fracturing back east was the flow-back period, when wells that were drilled for methane, for natural gas, after the hydraulic fracturing took place, flow-back would occur. And it would be flow-back of fluid into open air, into a sump, into a tank, but it was open, which allowed the methane to release while the water that had been used for the hydraulic fracturing job, flowed out and diminished.

California, we made sure that the rules are that the hydraulic fracturing, the flow-back has to be into tanks, at which point in time then you can separate the oil, the smaller amount of gas. We don't really have predominant gas fields up here in California or out here in California. And then the water can all be separate, and then the gas contained.

We also -- we can't forget the Aliso Canyon natural disaster which spewed billions of tons of methane into the atmosphere. That was a gas storage facility. A facility that used to be an oil and gas field. The wells that were used for that facility, some of them were the original oil and gas producing wells. They'd just been

repurposed for injection. So of them had been repurposed in a way that was not entirely safe and did not have two layers of protection.

We now have rules for gas storage facilities. We passed emergency rules, and have completed the final rulemaking for gas storage facilities to make sure that these -- these operations, which are inherently different than an oil and gas field, they look similar, they have very different operating conditions that we need to be concerned about, and that we need to be regulating, and which we are now doing.

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MR. MARSHALL: We've been working on underground injection control rules. Those are out for comment right now. I know that I've spent plenty of time talking with operators about that, and I'm sure we'll be spending more. But underground injection control is really the rules that we implement in California to make sure that the Safe Drinking Water Act, the federal Safe Drinking Water Act, provisions are met here in California.

We've been delegated authority for our UIC rules to substitute for the safe drinking water act. It's called primacy by the U.S. EPA. That's been in place since 1985, but there haven't been much in the way of updates of that since then. And so we are -- we are in

the midst of undergoing a revision to those underground injection control rules an update.

The subset of that, the Safe Drinking Water Act provisions and the aquifer exemptions, many people don't know that in California the vast majority of what oil and gas operators bring to the surface is water, 90 to 95 percent water, and they've got to do something with it.

About 75 percent of that water is actually reinjected back into the ground into those hydrocarbon formations for enhanced oil recovery to push more oil out of the ground. About 25 percent of that goes to water disposal wells, which are again usually old oil and gas fields that have been depleted, and now they're just being refilled with produced water.

About five percent of that water can be cleaned up and can actually be used for things like agricultural purposes or discharge -- believe it or not discharge to streams. Actually, on the coast, there's a stream that's -- habitat is being helped by the discharge -- after it's cooled, discharge of produced clean water.

The place where that exempt -- that injection takes place though has to be someplace that's approved by EPA. It's called an aquifer exemption. It's an unfortunate title, because it implies that aquifer -- I mean, it sounds good, right? Clean water. It's not clean

water. It's -- we're talking about waters that are below 10,000 parts per million TDS, but they often contain things that you would never want to consume, things like oil, or boron, or arsenic.

And so we go through a process when an operator seeks -- seeks an exemption, so that they can begin injection in an area. We go through a process of identifying, is that area hydrologically and/or geologically confined, separate from where other groundwater would be found, beneficial use groundwater could be found?

If we can demonstrate that with evidence in partnership with the State Water Resources Control Board, we then go ahead and put a proposal forward for the aquifer exemption.

As it says, it's exempting that aquifer from the Safe Drinking Water Act provisions, but it's exempting it because, well, what's there is too nasty for anybody to ever want to consume.

Lastly, those idle well regulations that I mentioned. When wells sit idle for a time, they really aren't being minded. Prior to these regulations, there wasn't any -- these regulations aren't in effect yet, mind you. We're working on them. But today, there's not really a requirement that operators go through and

regularly test and inspect their idle wells. They pay us some idle wells fees, but they're sitting there idle, not being tended to, and potentially filling with water, potentially corroding, potentially creating a conduit from the surface or from a subsurface hydrocarbon zone into a groundwater zone.

Again, if we don't know that that well remains competent, we have to be concerned about the possibility of leakage from that well.

So we're going through a process of adopting idle well regulations. We've put them out for comment earlier this month. We expect a very good discussion, debate. We've had a number of discussion draft vision -- visions -- revisions made in the coming -- excuse me, in the past months. And in the coming weeks, we expect to be making at least one more round of changes to those rules.

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MR. MARSHALL: Promise, last slide. So in summary, we're seeing declining production in the state. Price increases are unlikely to drive California production up. Foreign sources are going to predominate and fill the gap, we believe. And permits to maintain declining production are likely going to continue in existing fields.

Regulatory modernization is nearing completion,

and we look forward to being able to say we're a renewed and functioning -- fully functioning Division of Oil and Gas here in the -- by the end of this year.

CHIEF ECONOMIST WIMBERGER: Thank you very much.

Now, we're going to turn it to Strategic Growth Council.

(Thereupon an overhead presentation was presented as follows.)

MS. MIRZAZAD: Hello, everyone. How are you doing?

Okay. So feel free to stand up and stretch, if you need it. I'm the last one the row, so I feel the responsibility to tell that.

Okay. I don't see them. My -- okay.

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MS. MIRZAZAD: My name is Saharnaz Mirzazad. I'm with Strategic Growth Council. Before starting to present our approach to reducing VMT, I want to talk about the Council and who we are. We are established in 2008 to coordinate State agency activities in supporting the planning and development of sustainable communities. Our vision is to advance California's collaborative efforts to shape how and where we go and working to achieve equitable and resilient communities and landscapes for all Californians.

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MS. MIRZAZAD: We are a pretty small entity. It's only 20 staff. And we administer a suite of grant programs funded through the California Climate Investment, which is a statewide initiative that puts billions of cap-and-trade dollars to work reducing greenhouse gas emission, while providing a variety of other impactful benefits, particularly in disadvantaged communities.

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MS. MIRZAZAD: Today, I will talk about the transformative climate communities and affordable housing and Sustainable Communities Program with you.

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MS. MIRZAZAD: As most of you know, the transportation sector is responsible for more than 40 percent of the GHG emission in California. And like other agencies, you have been thinking how we can help to reduce the emission from the transportation sector.

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MS. MIRZAZAD: Other approaches are slightly different from other agencies. We wanted to know why Californian's drive so much. And when we think about that, it comes down to lack of location-efficient housing, and lack of quality low-carbon transportation options.

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MS. MIRZAZAD: And as many of you know, the State has a limited power over the land-use and zoning, but we thought that we have a role to play. And the role that we are playing is encouraging infill projects that reduce greenhouse gas emission and vehicle miles traveled through sustainable land-use housing and transportation practices.

And also increasing housing, employment centers, and key destin -- key destinations through low carbon transportation options, such as walking, biking, and transit.

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MS. MIRZAZAD: AHSC has been awarding affordable housing in the state for the three rounds now, and we have been able to provide -- to support 79 projects that -- with a 7 -- around $700 million in investment across the state. We have funded 6,200 affordable units, which we think that introduce 1.6 million metric tons of CO2 emissions, and approximately 11,600 less cars on the streets of California.

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MS. MIRZAZAD: The way that the program AHSC programs works is that we fund three types of different project areas. It's -- one of them is encouraging development in the transit-oriented development area, which is like high quality transit, which is like projects

that are in a half a mile of high quality transit including light rail or rapid bus.

We also fund projects that are not in that location, but are close to the transportation like a bus shelter or -- that's connected to a bus system overall. And we also have a category for rural innovation, which is a housing project in rural areas.

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MS. MIRZAZAD: The AHSC program funds different type of projects, mainly housing related. And there is some transportation-related projects that is funded along with that, with the main idea of supporting the people who live in this affordable housing to have access to the transit, bike lines, and sidewalks, or other amenities related to the transportation.

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MS. MIRZAZAD: TCC program was a -- Transformative Climate Communities Program was developed after affordable housing program. It's a relatively new program. We only had one round of funding so far. And it's the same line of thinking how we can reduce the need for driving for the Californians. And this is a placed based initiative to invest in the most disadvantaged communities of California to provide services to the residents of this area to be able to access what they need

in close proximity with active transportation and transit.

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MS. MIRZAZAD: If you have -- there are multiple projects that are funded under TCC Program. And these are -- the listed here are the strategies of the TCC Program. And under each of these strategies, like under equitable housing and neighborhood development, the applicants can ask for affordable housing same as AHSC program, which is in -- located close to the transit area or a qualified bus station.

We also fund a variety of transit accident mobility. Our applicants can request for fund to develop bike lanes for electric buses, or other variety of transit-related projects.

Other multiple -- other type of projects that they can ask to be funded that somehow relates to the transportation, but these two are the most -- directly connected to the goal of today's presentation.

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MS. MIRZAZAD: We have so far funded $140 million in the first round. The first $70 million has been fund -- has been awarded to City of Fresno to invest in southwest neighborhoods in the Fresno. $35 million to the Watts neighborhood in Los Angeles, and $35 million to City of Ontario in Inland Empire.

And we think the estimation shows that around 108,000 metrics tons of CO2e has been -- will be reduced through this investment.

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MS. MIRZAZAD: I provided a slide of what we are funding in Ontario, Inland Empire. Our applicants are asking for multiple projects, including affordable housing, which also along with developing this affordable using, they will give vouchers to residents of these affordable housing to use transit, also bike lanes that are developed along with this housing project, and also separate bike lines, which is under ATP program that these applicants have asked us to fund.

As I mentioned, our approach is pretty different from other agencies. And it's more integrated thinking about how to divert, and how the development happens, and supporting providing services to the Californians where they live

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MS. MIRZAZAD: And with that, this is my contact, and I'm happy to answer any questions.

CHIEF ECONOMIST WIMBERGER: Great. We are fast talkers, so we actually are a little bit ahead of schedule. I'd like to thank everyone for their presentations today. Transportation really is a

comprehensive source of GHG emissions, and it takes a team across the agencies to really work on this.

So we are going to break now for lunch. We will reconvene in this room at 12:30 for two technical panels. And that should be a lot of fun, so take a break, and we'll see you soon.

(Off record: 11:15 a.m.)

(Thereupon a lunch break was taken.)

P R O C E E D I N G S

(On record: 12:31 p.m.)

CHIEF ECONOMIST WIMBERGER: Okay. It is 12:31, everyone, so take a seat. We will get started.

Hopefully, that was a lovely lunch break for everyone. Thank you for joining us again. The configuration has changed up here, as you can tell.

So now, we're going to go into a little different spin on things. So this morning we heard from the different California agencies on how they are reducing emissions in the transportation sector. So now we have -- I'm very excited about this. We don't do this enough, I think. We have two different panels of technical experts to come and give their opinions on additional methods and policies for greenhouse gas reductions in the transportation sector, focusing on petroleum consumption, and then the second panel will focus on the production of petroleum. So we've got a great group. The bios are in the back, and I'm not going to bore you by reading everyone's bio.

But the thought is that we are going to have a robust discussion. I will serve as the moderator. We do want there to be the ability for the audience to ask questions, so we do have an ARB staffer who's got some note cards. If you do have a question for any of the

panelists. Please write it on the card along with your name and affiliation, and then we will pass those up to me, and then we will ask those questions to the panelists to the extent we have time.

So I should also note that there will be a public comment period at the end of both panels, so there is another opportunity to provide input generally. And any of the public comments will be part of the follow-up work. We're going to be putting together a synthesis of today's action, and that will be put together in a white paper. And that will sort of include all of the public comments and questions that we did not get to during these moderated panels.

So, okay, so to kick it off, we have the elder statesman of transportation policy in California. He is an ARB Board Member and also a professor at UC Davis, Dan Sperling.

DR. SPERLING: Elder statesman.

(Laughter.)

CHIEF ECONOMIST WIMBERGER: A very young looking elder statesman.

DR. SPERLING: Let me get my ahead around that one.

All right. So what I was just going to do is provide maybe a little more pithy presentation of what you

heard this morning, or didn't hear this morning. But I'm going to look at it in terms of kind of laying out the policy framework that we already have, and then talking about what could we do more. So I'm going to look at it strictly from a policy wonk perspective. And others here, I don't know exactly what they're going to say, but almost certainly will look at it in a more fundamental way in terms of strategy, and substantive -- you know, more substantive way.

So with that, I would say that in California here, I feel like we've put in place most of the policy instruments and regulatory instruments that we will want or need. And indeed, we have probably -- not probably, we have the most comprehensive set of regulations and policies with respect to the transportation sector anywhere in the world.

So -- and so what we've ended up with here is a fairly complex mix of instruments. And there's a lot of questions we can ask about their interactive effects and are they really achieving what we hope they're going to achieve? So I'm not going to go down that path, but I'm going to lay out what we do have, and then we can have discussion here.

So what we do have is we have greenhouse gas standards in place for both cars and trucks. The cars, of

course, is being threatened. We have the zero-emission vehicle mandate, which is the intent -- whose goal is to accelerate investment in light-duty vehicle technology. We have incentives in place for both light-duty and heavy-duty vehicles.

We have the SB 375 program, which is -- oh, now, I forget what exactly it -- the name of it is, but that's the Sustainable Communities Act of 2008. And the real goal with respect to what we're talking about is to reduce VMT. So we have that.

We have the Public Utilities Commission and the utilities developing funding programs for electric vehicle charging. We have the Low Carbon Fuel Standard for fuels to reduce the carbon intensity of fuels. And we have a heavy-duty, we'll call it, an action plan -- a Freight Action Plan for California that has essentially two components. One is the technology and that's leading to California -- CARB pursuing idea -- pursuing regulations to require and incentivize electric technology in trucks.

And then there's another part, what we call, efficiency part whose intent is to make the system more efficient with the hope that you would get the co-benefit of reduced truck VMT.

So that's -- those are the main things we have in place in California. And I would just make one little

comment about them, is that there are a lot of interactions that take place between these policies. And one that I'll highlight is with the Low Carbon Fuel Standard for instance. So in that program now, the credit for homeowners goes to -- for homeowners that charge their own electric vehicles, those credits go to the utility.

So now, we're about to adopt a new program that will create a statewide pool of those credits. And the money will be converted into on-the-hood payments to new car buyers. And it's going to be about -- probably about $2,000 we're calling it the POP Program, the -- where did they come up with that acronym? I'm struggling.

Okay. But it's -- so that's an example. There's part of the LCFS credits are also -- there's going to be a program to accelerate what we call capacity credits for hydrogen stations and fast charging stations, so that there will be an incentive to build those before they're otherwise profitable. And then, of course, there's the caps on refineries and fuels from the Cap-and-Trade Program that cuts across from -- that deals with both refineries and, of course, and also the fuels.

And it affects the price of fuel. So anyway -- so then I might ask what more is needed? And the first answer would be just that over time a continuing strengthen of these policies in terms of increasing the

targets, that they have to, you know, have a more stringent greenhouse gas standard, or there's more zero emission vehicles, or the carbon intensity of the fuels is increased. So that's kind of a natural process that ARB, and to some extent, PUC is involved in.

There's also probably -- there's a number of initiatives that are, let me say, not that effective. And one of them is SB 375. So one of the things is how -- SB 375, the goal of that is to reduce VMT from passenger transportation. So how do we make that a more meaningful, useful policy, more effective policy?

The Freight Action Plan I would say the same thing. We really are struggling to figure out how to deal with the freight system in terms of dealing with it as a large system, as opposed to a lot of pieces, and allow it or encourage it to somehow become more efficient overall, and therefore reduce truck VMT.

So that's probably, you know, some of the big ideas of what more is needed to improve some of the policies that -- and regulations we have in place. And then we get to what new -- what are some new ideas? And I'll just mention those quickly, because others are going to be talking about it. So I'll just go through them.

Feebates, one of my favorites for years, and years, and years. And that is the idea that you bring

signals to the market for the purchase of vehicles. If you buy a gas guzzler, you pay a fee. If you buy a very efficient vehicle or a low carbon vehicle, you get a rebate.

Transportation finance, that's something -- it's almost completely disconnected from environmental considerations. And so how do we use transportation finance to support the SB 375 Program is one way of looking at it. But it's just a way of how do we use transportation money, for instance, to build more bike infrastructure. And I'll now add to that electric scooters, because they go in the same place that the bikes do. It makes it even more compelling, I think.

Pricing of road use, which is part of transportation finance, and using that in a way that's also helpful. Not only from an environmental perspective, but also to accelerate the use of, what I'll call, pooled vehicles Lyft Line, uberPOOL, microtransit, those kinds of new services that are much more efficient than single-occupant vehicles.

And then one that's perhaps a little controversial would be the vehicle regulatory reform. So right now, the way the regular -- so for light-duty, the way it's -- the regulations are structured, trucks get a much more lean -- light-duty trucks, pick-ups, and SUVs

get a much more lenient treatment than cars, even though they're used in exactly the same way.

And then we have a footprint based approach, which means that there's almost no incentive for car companies to cell smaller vehicles, so it's taking away that incentive, and is one of the factors I think that's leading to the increasing proportion of vehicles being larger vehicles that are sold.

And -- but there's other good ideas built into that. So the car companies are asking for credit for their vehicles that are used as pooled vehicles. Like automated cars that are pooled shouldn't they get more credit in the regulatory process? And I happen to agree that that is something that we should do and could do.

And just to close, I would just say, you know -- and then, of course, there's a question of what happens if President Trump prevails in taking away California's right and reducing the greenhouse gas and CAFE standards? And the answer to that, I'll just flippantly say, is all of the above, and especially some new ones, plus some new ideas that creative people can come up with that might deal with bans on vehicles in city centers, fleet rules that there was a little discussion of this morning, changing registration fees in a way that's more attune to the carbon impact of the vehicles.

So that was probably a little longer than you wanted, but I think that's -- it's good for us to have a policy -- understand where we're starting from from a policy perspective. Although I'm very eager to hear what others say in terms of entirely new ideas.

CHIEF ECONOMIST WIMBERGER: Thank you very much. And I think that was a great summary, both of what we heard this morning, and more of the policy wonk focus as you mentioned.

I think it's important to remember the context -- one of the contexts for this workshop is that in the resolution to the scoping plan that was approved by the ARB in December, there is a statement that says that the ARB will come back to the Board and report on any new opportunities for significant cuts in greenhouse gas emissions from energy sources. And that includes supply side as well.

So I think something to keep in mind as we have a discussion today is both, as Dr. Sperling laid out, you know, how do we implement the policies that are on the books and that have been outlined in some of these more higher level plans, including the -- you know, the freight -- the freight work where they're -- we're still working on some of the regulatory aspects that will underlie and help achieve the targets laid out in the

plan.

And then also what is transformative? Especially in a state where we like to butt up against the federal government, which, you know, we're sharpening our pitchforks right now. But it's an interesting thought to think about jurisdictional overlap, and what do we do in a state when there is potential federal pushback or federal interactions.

So I would love to hear from panelists, both on ways that we can -- thinking about sort of the current state of play in the transportation system, how we can think about more revolutionary ideas in terms of pushing the envelope like California is want to do.

And so I would love to hear from Chris Knittel, if that's alright. Just -- you know, so we have some of the prompts that we were thinking about, I think, Dr. Sperling mentioned some, about feebates, about transportation finance. Something else that we've been thinking a lot at the Air Resources Board is in regards to the impact of autonomous vehicles, and what the future might look like in terms of transportation emissions if all of a sudden we do see a lot of autonomous vehicles.

We also -- you know, there's been a lot of speculation or thought about road charges that have been mentioned. And you've got a lot of history in this area.

Would love to hear some of your thoughts on where we go from here in terms of transportation policy.

DR. KNITTEL: Sure. Well, so first, thanks -- thanks for having me. Let me start with autonomous vehicles, because I think a lot of people view them as this huge transformative technology that could actually lead to deep carbonization. And the answer is a little bit more nuanced to that. And a lot of what I'm going to say is drawn from a former graduate student of mine Don MacKenzie who's at the University of Washington.

But the most important thing to realize about autonomous vehicles is that the whole point of AVs is to make them more convenient, and to reduce the cost of driving.

So I should mention I'm a card carrying member of the economics community, and I always view everything through that lens, even raising my 10-year old, which can be complicated sometimes.

(Laughter.)

DR. KNITTEL: But anyways. So what happens when you reduce the cost of doing something or you make it more convenient, you're going to get a lot more of that -- of that product. So what Don did in this piece, which I thought was really great, the conclusion is going to be a little bit unsatisfying. So let me warn you for that.

But he effectively went through -- he's an engineer, so he went through all of the engineering benefits of AVs from being able to -- light-weight vehicles, size vehicles correctly, platooning, and so on and so forth. And basically went through all of the things that AVs do well to reduce energy consumption.

And then on the flip side, there's things that AVs would increase energy consumption. And the biggest one being the demand effect, which is you're -- you're making them more convenient. So he went through all of these, added up all of those under different scenarios, and here's the unsatisfying answer.

What he concludes is that AVs can reduce energy consumption by 50 percent, or double it.

(Laughter.)

DR. KNITTEL: So that's his -- that's the conclusion of the paper, which is not a very great one. But what you should -- what you should always keep in mind is that obviously if we're on the doubling side, then it's going to depend heavily on what vehicles are driving around, whether they're zero-emission vehicles, or if they're internal combustion engine vehicles.

So AVs are not likely to be the solution. There has to be something upstream from the AV that makes them solution -- the solution, like everything is electrified

at that sense -- standpoint.

So if California wants to decarbonize transportation, they shouldn't be thinking about AVs as doing it. They should be thinking about, okay, how are we going to decarbonize vehicles, and then let autonomous vehicles do whatever they want to do. We don't care, because those will all be zero-emission vehicles that are on the road.

The other thing that I'll mention is, you know, I think California should obviously be thinking what happens if the waiver is rescinded?

And just from an economics standpoint, let me say, I don't think that's necessarily that big of a deal for something that Dan mentioned, which is the economics of fuel economy standards are the exact economics of a feebate program. All fuel economies do -- standards do is create this implicit tax subsidy program. They do it inside of the manufacturers. So if I'm selling a vehicle that's better than the standard, and I'm GM or I'm Toyota or I'm Honda, I'm willing to sell that vehicle at a slight loss. So I internally subsidize that vehicle.

You might ask yourself why would I be willing to do that?

Because that allows me to sell a vehicle that's worse than the standard at a tax, at a big markup. So

Toyota is willing to sell that Prius at a loss, so that could sell a Sequoia at a big premium.

And that's exactly what a feebate program would be. So you can replace the fuel economy standards very easily. In fact, I'd love you to do this to -- and tell the administration this, we're just going to replace it with a feebate program, which is the exact same economics. So there.

So I'll stop there and see what Emily has.

CHIEF ECONOMIST WIMBERGER: I like that, "So there".

(Laughter.)

CHIEF ECONOMIST WIMBERGER: It'sa good response for 10 year olds and the federal government alike.

So I think part of it, too -- and I love the framework that you sort of provided with the economics, and how we're thinking about autonomous vehicles. I guess as a follow-up, this is the million dollar question, I have a lot personally riding on this. I have a bet with a friend. When do you think autonomous vehicles -- I mean, is that -- what's the time frame for this? What is -- is this realistic? Is this Jetsons? Is this next five to ten years?

DR. KNITTEL: Yeah. So I should have mentioned that MIT right now is working on the Future of Mobility

Study. So I should have certainly marketed that. And this is a group of probably 15 researchers that are sort of diving into what we see as the future of mobility.

So obviously, autonomous vehicles is very much on our mind. I'll say - and this is not from the economist perspective, but just the engineers - the engineers at MIT at least seem to be pretty pessimistic that AVs are right around the corner. They seem to believe that for the next 30 to 40 years, we'll have computers as co-pilots, we're referring it to.

So, you know, we'll have smart cruise control, we'll have automatic breaking, lane detection warning that for the next 30 to 40 years will leverage a lot of the safety benefits from autonomous vehicles, but we're nowhere near a world where all the vehicles on the road, or even a large subset of them, are driven by computers.

And one of the reasons for that is there's a huge coordination problem with this in the sense that it would be one thing if we could snap our fingers and have all vehicles be autonomous. That would be a much easier world than slowly getting -- increasing the penetration of autonomous vehicles into the marketplace.

Plus, there's the issue -- I know it's not a problem in California, but if you -- if you've ever driven in Boston, most of the roads don't have lane lines, most

of the roads you don't even know if you're on the road. And then there's this problem of snow that covers lane lines and things like that. So there's a lot of technology that needs to come about before we're in that world that I -- that everyone seems to want to be in.

DR. LANGER: And if I can just chop in on that. As part of this transition, one of the things that really worries me is this idea that even with partial automiza -- autonomization, you have a decrease in the cost of driving. That means there's just a lot more miles from those cars. And everybody who's left on the road in internal combustion engines is in more congestion, stop-and-go driving, worse fuel economy per mile.

So it has to be thought of, in some context, as are you going to price the miles, are you going to price the congestion. Because in that transition period, it's going to impact the cars that are still burning gasoline.

DR. SPERLING: And jump in with a policy wonk perspective following up on that, because to me the real crucial issue is whether these vehicles are going to be, not only whether they're electric or not, but the more crucial one, in many ways, is are they going to be individually owned or are they going to be part of pooled mobility services?

Because if they are individually owned, that's

where you get at, what Chris was talking about, the doubling of the VMT. But if they're pooled, then you'll have less VMT. And incidentally, you'll have more passenger miles traveled, so you have more mobility and accessibility. And that means low-income people the cost of will come down, and it serves low-income physically-disadvantaged people at much lower cost.

So the challenge for policy is how do you direct those automated vehicles as they come along toward the public interest, meaning toward pooled services? And I'm not -- and we're not quite swimming upstream on that one, because many of the car companies already think that's in their interest, and companies like Uber and Lyft think it's in their interest. But we've got to do it, and we're not, and we should start now.

CHIEF ECONOMIST WIMBERGER: Do you have thoughts on how we do that? What are the next steps in terms of are there regulatory barriers, are there technology barriers? What do you see as the big stumbling blocks for sort of realizing that --

DR. SPERLING: Okay. So I'm just sticking with the pooling, you know, because on the electric side, there's -- actually, the Legislature -- California legislature already is exploring regulations on how to make them electric. But on the pooling side, it is -- I'm

with the economists here.

Are you all economists, by the way? Am I on a panel with four economists? Is that what happened?

I am. Okay.

CHIEF ECONOMIST WIMBERGER: Sorry.

DR. SPERLING: I'm with you. Okay. So here -- I'm with you all this -- on this one. Not always, but on this one.

(Laughter.)

DR. SPERLING: Chris and I were actually faculty members at UC Davis for many years and had many lively discussions about all of these topics. Lots of fun.

But the policy instruments, right away we start out with cities and airports are already pricing these vehicles. You know, New York, Washington D.C., Chicago, and at San Francisco Airport they put fees on these. What they should do is put a high fee on the single-passenger service, and a zero fee on the pooled services. And -- you know, and then you can work with the curb space which is even, you know, simpler. You just say if you're a pooled vehicle, you get lots of curb space at the airport and cities. And gradually, we -- Uber and Lyft feel like they're being picked on treated as cash cows on this, and they are.

And so it should be gradually transferred to this

pricing to all single-occupant vehicles. If it's a single occupant vehicle, and we're in California, we're starting to play around with these congestion pricing, so we'll have the technology in place and the mechanisms in place to do it. But we should start with the pooling, and we should do that for -- we say any automated vehicles that come in, they're going to be treated very positively if they're used for pooled services, very unfavorably, if they're not.

CHIEF ECONOMIST WIMBERGER: That sounds good.

So I want to sort of step back to something that I think both of you mentioned, which is the federal interaction and what is happening in the rest of the United States in terms of the Trump administration, and their position on fuel efficiency standards.

So I wanted to ask Hannah Pitt from Rhodium Group, who has sort of a more federal perspective, what do you see as -- do you see as what is done in California is that really sort of a first mover, and we see policies adopted elsewhere, or do you see any trends outside of California that either give you hope on some of these technologies or policies being advanced? Are you more pessimistic, is your glass half full or empty?

MS. PITT: Thanks. I -- I'll start with some pessimism, but then move to some optimism.

So I think the -- Rhodium recently looked at the impact of rolling back CAFE standards nationwide. And the impact will we big. It will be, you know, one, if not, the biggest rollback in terms of cumulative (sound file went out) -- the rolling back of oil and gas regulations for methane.

But I think it's important to remember that, you know, this story is not only about Trump. That, you know, making progress in transportation has challenges all of its own, aside from the federal government, that, you know, both provide -- there are challenges, but there also provides some windows of opportunity.

So I think in terms of, you know, electric vehicles, this is a -- sort of a good way to explore that. You know, on one hand, electric vehicles nationwide are -- there's more momentum now than there's ever been with California leading the way.

Some recent modeling work that Rhodium has done at the national level show that under sort of the most optimistic scenario for transportation policy, that ZEVs can get up to 35 percent of new sales by 2030. And I think that's -- you know, that's reason for optimism. That's four times higher than the AEO reference case projects for that same year.

And I think at the same time, you know, other

modeling that we've done shows that ZEVs would need to reach 70 percent of new sales by 2030 for the U.S. to be on track for deep decarbonization. So there's a lot of scope still for more ambitious efforts. And for more -- the sort of the creative and ambitious policies. Like the policies that most of the country are using to move ahead on transportation, CAFE and ZEV requirements, even if taken to their most ambitious levels, still only get us like halfway to where we need to be, at least in terms of electric vehicles.

So I think I -- I see sort of a few broad areas for California policy, but really for State policy to move transportation ahead, sort of whether or not the Trump administration is behind us.

And so these are both, just listening to the discussions so far, I think a combination both of ratcheting up existing California level policy or other State policies that are similar, as well as sort of introducing new policies.

So the first area I think is continuing to push technological innovation, particularly on electric vehicles, that can help ensure that California meets its ambitious goal -- ZEV requirement goal. And I think there's a lot of different policies here that can -- that can contribute. You know, smart investment in charging

infrastructure, as we were just discussing, ensuring that autonomous vehicles and ride-sharing be all electric.

I think maybe more fundamentally there's a lot of scope to increase the awareness of consumers. I think that -- even that -- most consumers still aren't aware that electric vehicles are even an option, let alone understand sort of their lifetime savings relative to a conventional vehicle.

So that's both -- I think there's a lot more to be done, both in terms of sort information for consumers, and also being creative about incentives, you know, point-of-purchase incentives, for consumers, but also for --

DR. SPERLING: Point of purchase, that's what it's called.

(Laughter.)

MS. PITT: Yeah, when you said that -- which I'm glad to hear I think is now being piloted in California or has been introduced.

(Dr. Sperling spoke off the record.)

MS. PITT: Great. So, yeah, on the consumer side, but I think also on the -- the dealership side, that their, you know, incentives can be better aligned, so that when someone walks into a car dealership, that that dealer is showing them electric vehicles. I think there's been

evidence that that's not happening.

I think some of the more potentially extreme, but maybe -- you know, something to consider are bans on internal combustion engines. Potentially less extreme now that many, you know, big economies have adopted those goals, at least in the 2030 to 2040 time frame.

I think -- so the policies around electric vehicle adoption, as well as CAFE, these focus on new sales. And I think it's important to recognize that your greenhouse gas implications of policy that focuses on new vehicle sales has a real long delay, because of the slow turnover of stock in vehicle stock.

So another sort of broad area of focus is ensuring that we're targeting greenhouse gas reductions for the fleet as a whole. And I -- I won't go too much in detail here. I think we'll have more time, but, you know, things around reducing the amount people drive through policies that target VMT. And I think to do the best we can to penalize driving in high-emission vehicles and/or sort of rewarding driving in low-emission vehicles.

So, for instance, the way that there's preferential treatment for ZEVs -- for electric vehicles in each HOV lanes. I think we can take a lesson from that to some of the other policies that I think we'll be discussing later.

And lastly, I'll say, so as part of our -- as part of Rhodium's national level emissions modeling, we also do 50 state emissions projections. And for California, based on our numbers, transportation emissions look like they're going to follow twice as fast as the U.S. average to -- from 2005 to 2030. But at the same time, heavy-duty vehicle emissions will grow twice as fast as the rest of the country.

So I think there's a lot of scope to sort of focus efforts on heavy-duty vehicle fleets. It sounds like California's is moving in that direction, but that that can really be an opportunity to sort of stem the growth in heavy-duty vehicle emissions going forward.

Yeah, so that's all I'll say for now.

CHIEF ECONOMIST WIMBERGER: Thank you.

So in a world in which California is leading the way on clean vehicles, I think the other piece of the puzzle then is the miles that these vehicles are driving. So I wanted to ask Ashley Langer from the University of Arizona what you think is -- how does this go hand-in-hand? How do we think about reducing overall emissions when we are -- we've got the right -- we've got incentives, a lot of policies in place to really incentivize cleaner vehicles, what do we do next?

DR. LANGER: Great. Thank you. Yeah, it's

really interesting coming from Arizona and hanging out in California for the day. Maybe people listen a little bit more.

But one of the things that strikes me here is the recurrent theme of subsidies for clean vehicles. And that's great, but that still means more cars on the road, unless you're doing something like a feebate, where you're trading off across cars.

And so one of the things that just pops out to me, also in the context of new AV technologies, is that, you know, I'm going to be an economist and say pricing, pricing, pricing. But to some extent, you need to -- you need to figure out how to reduce mileage. And, you know, California does have these hyper long commutes, right? You see, in particular, low-income workers commuting from very far outside of San Francisco and L.A. coming a very long way. They're not going to be the first adopters of new technologies. They're going to be in internal combustion engines for a long time.

And, you know, a congestion toll is good, but it's really going to hurt those drivers. And so I'm going to say something that's probably completely not welcome, but you need to build more housing close to where the jobs are, right? I mean, but we don't always think of that as a greenhouse gas policy. But fundamentally, you can't

have very small amounts of housing on the peninsular in the Bay Area and have drivers coming from the Central Valley and think that just by adding some electric cars, that's going to make the difference. If you really want to get 30, or 40, or 45 percent reductions in greenhouse gas, you've really got to think about the miles driven.

So that does mean pricing, but pricing can only go so far if you don't have the housing, or the public transportation options, or the group vehicle options. If you don't have other options for people, then the pricing ends up being mostly just a transfer. And that transfer is going to be regressive, right?

It's going to be the poorer people who are having to drive a long way, because that's where they can afford housing, who are going to be paying more of the tax.

So my sort of scream-it-from-the-rooftops think on all of this is, you know, I think we should think more creatively and more broadly about what greenhouse gas policy means. And that means thinking about urban land use, that means thinking obviously about public transportation, but about how you increase people's options perhaps so they don't need to drive as much.

CHIEF ECONOMIST WIMBERGER: I think that is a challenge thinking comprehensively and cumulatively, not only about GHG reduction policies, but, you know, what are

the other co-benefits, and how do we think about this. As Dr. Sperling mentioned, all these policies interact together, and we're not only dealing with greenhouse gas emissions in California, we do have a lot of rules on the books in regards to localized air pollutants. So we do want to make sure that we are going full-steam ahead in terms of all of our goals.

One thing --

DR. SPERLING: Could I, before you go on?

CHIEF ECONOMIST WIMBERGER: Yeah. No. Go for it.

DR. SPERLING: Could I highlight something that Ashley said that I think is really important as we talk about VMT as we need to create choice. We have almost no choice. Most people -- and that's why I think a lot of people oppose the gas tax increase. It's just what Ashley was saying they see it as just punishment, because they don't have any choice. It's a little overstated, but -- so what we need is choice.

And that is -- that's why I've become a big champion of all these new types of mobility services, everything from these little electric scooters, you know, electric bikes, you know, dock-less bikes, the uberPOOL, Lyft Line. And even though uberX and traditional Lyft services by themselves tend to have an increase in VMT.

As people get more choice along with car sharing, they have more choice. And then we can start seriously pursuing these pricing policies that are compelling. And they -- one, they won't -- they'll be politically more palatable, but also won't have the negative equity effects either.

So, yes, for choice. What's more American than that?

DR. LANGER: Totally, totally agree. I guess the one thing I would say is, you know, an electric scooter only gets you so far. And, you know, coming from Tucson, Arizona, where we don't have the same issues of land constraints, you know, we're building multiple 20-story buildings around downtown right now in a way that is making -- causing some political tension for sure, but they're within, you know, half a mile of public transportation, and they're within a couple miles of downtown, and then public -- then scooters and bikes and all those things become much more viable than trying to drive across town, which now is only five or 10 miles, but it's Tucson, Arizona, so the roads are big and congested and not safe. So I'm just going to scream again about housing.

DR. SPERLING: Yeah, well, I agree with the housing. But also your point is also it leads to the idea

that if there's choice, people also can give up car ownership. Because really what we're aiming for is a future where these automated vehicles are pooled. You know, you press a button, it comes to your door, takes you wherever you want to go, and with a few other people along the way. And it will be a much cheaper transportation system. It will be more equitable, because it will be cheaper and accessible to a lot more people, and being environmentally better. Be better for transportation infrastructure. You won't need as much.

So but it's the idea of making choice, so that people can give up car ownership. And if you have that scooter that goes to the transit line, or just uses for local trips. I just was using it this morning in L.A., and had so much fun. And they're a lot of fun besides, and I'm an old guy, so -- but I think that is central to what we're talking about.

DR. KNITTEL: Emily, I just want to back up a little. So this session is, you know, opportunities for reducing greenhouse gas emissions from effectively transportation.

One thing I would encourage California to be thinking about, so, you know, basic economics is we know if the only thing you care about is climate change, and that's the only thing wrong with the economy, then we know

how to reduce greenhouse gas emissions perfectly. You do it through a carbon tax or a cap-and-trade program.

So once we're in a world where we think that we need to reduce greenhouse gas emissions more from transportation than what that cap-and-trade policy would do, we're basically presuming, and I'm not saying that it's not correct, that there's this -- there are other failures in the market that we have to address, whether that's -- there's innovation failures that won't allow electric vehicles to get over the hump, or innovation failures on autonomous vehicles, or housing failures, and so on and so forth.

So I think it's always good to come back to that, because that guides policy a lot. If you -- if you're saying we need to do more in transportation, something in the back of your mind is believing that there's another failure somewhere, and you probably have a good idea of where it is.

So once you -- I would first focus on that, and focus on understanding what that additional failure is. And then that allows you to think about policies that are more targeted and more efficient than just, well, we need -- we know we need to do more in transportation, so let's do a Low Carbon Fuel Standard, or something like that, right?

Let's first identify what that Low Carbon Fuel Standard is trying to fix. And that would probably provide very good guidance as to how to fine-tune the policy choices.

CHIEF ECONOMIST WIMBERGER: I'm going to make you talk some more. So a lot of the discussion has been about, you know, providing options in cleaner transportation. The other part of the equation is behavior. How do we get consumers to either demand these options, to use these options, to want to ride the electric scooter relative to a gas guzzler? What is the role of behavior in consumers in this in a world in which there are many multi -- or there's multiple market failures?

DR. KNITTEL: Yeah. So one market failure I often hear people believe in is that consumers just don't value fuel economy. That they undervalue fuel economy, so when they're at the -- you know, they go to the dealership thinking they're going to buy a Prius and they walk out with Corvette, because they just don't realize how much money that they'll save.

The one thing I'll mention, and this is one of the topics that Dan and I have had many a conversation about, at least the most recent empirical evidence suggests that consumers actually more or less get it

right. That consumers do a good job at trading off upfront costs, buying a hybrid version instead of a standard version for future fuel savings.

Now, I'll admit one of those recent papers is my own. So clearly, I think my -- I got it right, but --

(Laughter.)

DR. KNITTEL: So there's room for disagreement in this literature. But if that's the case, then that takes away one of those additional market failures that we're trying to fix. I still believe that there are market failures -- the potential for market failures in innovation. And that's where I would be focusing my efforts on. Less probably -- and this is strange for an economist to say, but less about how consumers are behaving, because I think consumers are pretty smart in terms of how they purchase vehicles, and more thinking all right what are the impediments to electric vehicles, what are the impediments to hydrogen vehicles, or whatever we think the quote unquote right technology is.

And I think with the electric vehicles, we know what that is. The world would be such a different place if batteries were cheap. Batteries are just still very expensive, whether we like it or not. Even if Elon Musk, who claims to be building batteries at $150 a kilowatt hour is correct, that's still well above where it has to

be. At $150 a kilowatt hour, you need oil to be about $100 dollars a barrel for electric vehicles to win over internal combustion engines.

Now, you can make them win by subsidizing them. But we want to be in a world where we don't have to subsidize them. So the key is I think innovation activity around getting better and more efficient battery technology.

DR. SPERLING: Can I weigh in?

Reminiscent of our argument. I mean, I completely agree on the innovation. I'm not going to get into the details of that. But the behavior I do, cause I think part of the problem with when people do these studies -- so I haven't seen your latest paper, Chris, but the reality is that most new vehicles are bought by rich people. You know, like 25 percent of the people by 80 or -- percent or more of the vehicles.

So -- but they only keep them for a few years. And so those decisions being made by those relatively rich people are being carried over for everyone else. And it -- you know, it's how they value it, and how they measure it.

And so these vehicles last for a very long time. And I'm not sure that -- so when an individual makes a choice, they're saying okay, well, I'm only planning on

keeping it for three or four years, so I've got to get my money back in three or four years. And if you do that kind of analysis, you know, it comes out very different than if you said, okay, there's the fuel economy savings over the whole life of the vehicle, which is how you would look at it from a societal perspective, and a policy perspective

DR. KNITTEL: Yeah, but -- so that's where you can directly see this in the data. You know, used vehicles prices reflect fuel savings as well. So if -- even as a wealthy person buying a vehicle -- so let's imagine -- it's direct, if you're actually leasing the vehicle, right? Because when you're leasing the vehicle, what you pay for is the upfront cost minus the value of it at the end of the lease.

Toyota knows that more fuel efficient vehicles are worth more after the lease is over. So that residual, or what you're actually leasing the vehicle over, is directly impacted by the fuel economy of the vehicle.

On -- even if I'm going to sell it in the secondary market after buying it new, we see, in fact, that it's even more pronounced for used vehicles in the data, where when gas prices go up, that used Prius that I have in my garage, the value of -- if gas prices go up by a $1, that Prius increases value by $1,500 overnight.

It's amazing. You see it directly in the data.

Whereas that Yukon that I have in my garage, falls in value by $1,000. So new vehicle owners apparently see this and they know this. So when gas prices are high, they invest in fuel economy. Or if you have a version that's ore fuel efficient, they're willing to invest that, even if they're only going to own it by -- for three years, because they know at the end of the three years they'll be able to sell it at a higher price.

So, you know, we could -- Dan and I have gone round and round on this for the last 10 or few years. We're probably not going to solve it today, but I'm always happy to relitigate it.

(Laughter.)

CHIEF ECONOMIST WIMBERGER: This is why they're on opposite ends of the dais today.

(Laughter.)

CHIEF ECONOMIST WIMBERGER: And, Chris, what color is the Yukon in your garage? I'm very --

DR. KNITTEL: I don't own a Yukon.

(Laughter.)

CHIEF ECONOMIST WIMBERGER: So we're going to take a few questions from the audience. This question is from David Weiskopf with NextGen, generally to the panel. To meet 2050 targets, when must new vehicles sales be at

or near 100 percent zero-emission vehicles, is the question?

DR. SPERLING: I mean, Joshua should answer that question. I mean, I think the CARB -- the analysis that CARB has done is by 20 -- you know, just because of turnover by 2040, almost all of them would have to be plug-in hybrids or pure ZEVs of sales.

CHIEF ECONOMIST WIMBERGER: The response from Joshua Cunningham was 100 percent of new vehicle emission sales by 2050 have to be zero emission for the California climate targets.

Let's see, we have another question, which is -- sorry, handwriting reading is not my specialty. So this is a question to discuss sustainable communities with electric vehicles and autonomous vehicles. What are infrastructure needs? So in thinking about innovation, is it innovation that's necessary just on the vehicle side or what are the requirements for infrastructure in thinking more comprehensively about getting significant GHG reductions?

DR. KNITTEL: Well, at least with EVs we know the recharging infrastructure is going to be key. And I think a recharging/fast charging infrastructure that allows either reduce the range required in these vehicles, which then allows you to reduce the battery size is going to be

important. And, Dan, you might know offhand, but my hunch is thanks to the VW settlement that California is going to be getting a big check, and where those revenues or resources are going to go on the recharging infrastructure piece.

DR. SPERLING: A lot of that is going. I believe 35 percent of one pot of it goes for disadvantaged communities.

DR. LANGER: So -- and to put a post for the Energy Institute at Haas blog, there was recently one talk -- I think that Severin wrote, talking about charging for apartment buildings and for people who don't have just single-unit housing.

Lucas did it. So Lucas Davis wrote it.

But I think that's also critical thinking about how do you do this, if you don't have a garage, or you don't have your own driveway to put the charging station.

DR. SPERLING: Yeah, that is a good point. We need a lot more fast charging for those multi-unit dwellings. We need it also for if we want all of these Lyft and Uber type cars to be electric, they have to be fast charged. And so we need it for that purpose as well. So I think that's the one area we -- we're definitely underinvesting in.

CHIEF ECONOMIST WIMBERGER: We have another

question from the audience. What are your thoughts of reducing California population to help improve air quality and achieve additional GHG reductions?

DR. KNITTEL: Well, so having moved from California to Massachusetts, partly because of resource constraints in the UC system. So one way is just to make the UC system worse, and then you'll get faculty to leave and go to other universities.

(Laughter.)

DR. KNITTEL: That's probably not the answer you wanted to hear though.

CHIEF ECONOMIST WIMBERGER: I'm not sure there's a right answer.

So one question I did want to ask, in terms of -- and I think Dr. Sperling hit on this -- in terms of what is the role of State policy, and do you see any barriers to implementing some, what you might consider, more revolutionary technologies that can be ameliorated at the regulatory level by agencies? Is there room -- what is -- what is the role of perhaps the UC system in pushing Chris out, but to do -- in research versus what the role of agencies at the State level, you know, in sort of trying to reduce some of these regulatory impediments? Does anyone have any thoughts about sort of like who picks what? We have a lot of different jurisdictions that touch

vehicle emissions and transportation, both on the infrastructure side, the vehicle side, the fuel side as we heard about this morning, is there a way to think about how we can do things better at the policy level to really start getting, you know, deeper reductions, and, you know, to address some of these additional market failures that might be seen? And I was just looking at you, but you don't need to answer, so...

DR. KNITTEL: So I'll just throw one out, and let Dan respond. And we were actually talking about this thing -- this at lunch, but -- so I've been a vocal critic of the Low Carbon Fuel Standard. One reason for -- that's --

DR. SPERLING: That's why we had many discussions.

(Laughter.)

DR. KNITTEL: One reason for that is I think, at least on the margin, it provides too much incentive to make corn-based ethanol a little cleaner. So you get a lot of -- you get more innovation, but you probably get it in the wrong spot. And I think for deep cuts, like 80 percent by 2050, we need transformative technologies, not just a little bit cleaner corn-based ethanol.

So one policy change or alteration in the Low Carbon Fuel Standard would be to only apply it to zero or

near-zero emission technologies, whether that's cellulosic ethanol which is at the near zero, or EVs, which at least if you ignore the upstream emissions, is at zero, or a technology that I was just having a chat with a Harvard professor yesterday about this, or on Friday, where he has a new technology that takes CO2 out of the air and does gas to liquids with that carbon. He believes he can do that at $100 to $150 a ton.

That would be transformative, because you'd be taking CO2 out of the air and turning it into a liquid fuel. That seems like the type of innovation that society needs, rather than again just marginal changes to corn-based ethanol.

DR. SPERLING: I'll just -- you know, one other idea is regulatory certainty. And that's a big challenge is, you know, to make sure that incentive really -- they believe it, and that's important. Of course, easy to say.

CHIEF ECONOMIST WIMBERGER: Okay. I'm going to take a question -- an internet question from Darrell Clarke. I'd be interested in more comments about consumer incentives to reduce VMT from traditional transportation demand management plans to potential use of cap-and-trade funds just to pay people to carpool, use transit, et cetera.

I guess is there -- is there room for once you

have this suite of options, how do we then incentivize people to actually use those options?

DR. SPERLING: Well, I think transportation planners and policy have largely failed, so we need to look at new ideas and new ways of thinking. So one idea, and this is controversial in the CARB world, and it's not CARB policy, so this is Professor Sperling speaking, is we should think about it as a way of increasing mobility, increasing passenger miles traveled, and not focus strictly on reducing VMT.

Strictly reducing VMT is -- politically, it's not going to get very far. And at the end of the day, you know, by itself it's not really what we want to do. We do want to improve. There's lots of segments of the population that would benefit, and would desire more mobility. And so that's how we should think about it, and not just reducing VMT. And, you know, part of it goes back to the discussion Angela and I -- Ashley and I were just having about creating choice, and so that people do have options.

DR. LANGER: Yeah, I mean, I think to jump in there, it's not only do you want to make the transportation options more attractive, but you could also make the need to travel less pertinent, you know, that you don't need to go multiple hours to get where you need to

go. And I think, in general, the -- you would like -- maybe this ties back to the population question in some sense. The goal here is to make people better off, right? And that should be the goal of greenhouse gas policy. That's make people globally better off, right? Not have the planet warm, not have all these bad outcomes, but also to make people's lives better off, and not spend time sitting in congestion behind the wheel with nothing else to do.

And so my take on this is sort of just the idea of again to think holistically, but to think about where you want to go, how you want to get there. And I don't know, I mean, Dan keeps going on about uberPOOL. And as an extreme introvert, that sounds terrible to me.

(Laughter.)

DR. LANGER: But, right, I mean, we need options that are attractive to people, right? We can't just be thinking about this from a pure planner/policymaker perspective and saying this sounds like a good idea. If people don't want to do it, then it's not a good idea, right?

So we want to think about, you know, what's a nice way to get where you want to go without using as much carbon, or to do what you want to do in your life, you know, to get to work, to go to the grocery store, to pick

your kids up from school in a way that reduces your impact on others, and the environment, and whether that's walking and having child care options out in neighborhoods, having child care -- there's a beautiful child care facility right here. Thinking about all those things we do every day, and how we can make it easier to do those things without using an internal combustion engine.

I mean, California has the opportunity here to be a leader worldwide, and partially a leader in making the world nicer, and making our lives nicer. Now, that might lead to more people living in California, but that means they won't be living in Arizona where we have much higher fuel use per person, I'm sure.

So maybe that's -- that's a good thing to strive for in terms of the development of the world.

MS. PITT: Just to add something that might be somewhat obvious, but targeting VMT per se doesn't necessarily get at emissions. You know, in effect, you're treating a Prius the same as you would treat a Hummer for any given mile traveled.

So, I mean, I think -- you know, no policy will perfectly address the issue at hand. But I think when designing policies, we want to make sure that where at -- we're trying to get as close as we can to the actual, you know, target issue in this case being emissions. And so,

you know, having an instrument like VM -- just targeting VMT is a little blunt and could have some negative repercussions that my colleagues just pointed out, in terms of quality of life and ease of mobility. So, yeah.

DR. LANGER: Yeah, just one plug for my recent research that Chris was the editor on, so we're all up here. We looked at VMT taxes versus gas taxes. And just a straight VMT tax is sort of okay. But as soon as you start differentiating it, like if you can charge a different price urban VMT and rural VMT, you get much bigger gains, especially in a world where fuel economy is improving, and so a gas tax becomes less and less useful.

So thinking about -- and this ties back to what Christ was saying about targeting what the real problem is, whether it's congestion or local air pollutants, or greenhouse gas.

CHIEF ECONOMIST WIMBERGER: We have another question from the audience, and it has to do with low-hanging fruit in the transportation sector. So we are seeing a lot of what we need to make reductions in transportation fuels feasible relies on technological advancement. We are seeing this in other market-based programs, like the Cap-and-Trade Program, where the easiest or cheapest reductions are done first.

If transportation emissions aren't budging, is

there any solution? If we don't see EV penetration or fuel cells develop, are there low-hanging fruit left in other areas that we would need to explore?

I hope that answer is yes, low-hanging fruit is always a good idea.

DR. SPERLING: All I can think of Mary Nichols reprimanding me saying, in hindsight lots of things look like a low-hanging fruit, but at the time, it's not. And, you know, I think if it was low-hanging fruit, we would have done it is kind of --

DR. LANGER: I'm going to -- I just asked Emily if I get to scream housing again, right? I mean, I lived in Berkeley for six years.

DR. SPERLING: I say feebates are low-hanging fruit too. But actually did have a chance to try that out on the Governor, and he said does that require a two-thirds vote? Forget it.

CHIEF ECONOMIST WIMBERGER: That's that whole other level of complexity.

So one thing I think was mentioned a bit was the interactions of different policies. And in California, we get accused a few times of having -- you know, wearing lots of belts and lots of suspenders. So I wanted to get the panel's take on efficiency of regulatory actions and policies, and what you see as the future? Is it more

targeted policies that address specific market failures? Is it more overarching policies that -- you know, fewer overcharge policies? Where can we think about efficiency when we're -- there's a lot of economists up here. So how does efficiency fit into what we're doing in California, and both with interactions at the air district level when we're thinking about air pollution, at the federal level when we're thinking about the actions of EPA? I wanted to see if anyone had a take on efficiency in this space.

DR. KNITTEL: So one thing I'll say, which is sort of related to your question but not entirely, is I do think -- and having, you know, grown up in California, and now living in Massachusetts, I'll definitely say California is certainly a leader, and is looked upon for leadership in this space.

So I interact a lot with the Massachusetts Legislature, Massachusetts has had a carbon tax bill -- two carbon tax bills on the floor, the most recently -- most recent energy bill out of the senate would have required carbon taxing -- or a carbon tax or a cap and trade by 2020. It passed unanimously. That provision was taken out for the house version of the energy bill, so -- and they never reconciled that.

But in my discussions with Massachusetts legislators and the Governor's office, I frequently point

to how California has had cap and trade, and it hasn't destroyed the economy. And, you know, pointing -- so it's effectively -- California is serving as this demonstration project for the rest of the world.

So the reason why I bring that up is, I think, in large part, that's probably -- well, I know from a climate science perspective, that's where the big benefits are going to come from California doing something. California reducing its emissions is not going to affect the climate, but it can serve as a demonstration project for Massachusetts to pass it, all the eastern states, or at a federal level at some point.

So the reason why I mention that is I think that's why efficiency of these policies, and doing them correctly, and not relying on policies that the rest of the world can point to and say, look, California is doing this crazy policy, look at how expensive it is. And then that message gets conflated with therefore we shouldn't do anything for the climate, right?

What we really want is California has this Cap-and-Trade Program. They're getting emission reductions for only $15 a ton. It hasn't negatively impacted the economy, therefore we should do something about the climate.

That -- so I just want Californians to realize

that that puts even more stake at choosing the right sets of policies, because if you set the -- if you choose the wrong ones, it can put climate change policy more generally at -- back for decades.

DR. SPERLING: Yeah, let me -- so, I think that's a really good point is -- and I think we're very sensitive here that what we do is as a model. We're not an island, and what we do is imitated around the country, around the world. But the question is what is the best approach? And to go back to the question, if we could do a strong carbon tax or, you know, really aggressive Cap-and-Trade Program in any -- any card-carrying economist, and I'm sure all four on this panel would agree, that's the best -- the most efficient approach. But we know we can't do a carbon tax or a cap and trade of that strength or intensity.

And so then we look at a lot of these other instruments, and that are more specific. And there is a question -- you know, and some of them they hide the costs, so those are popular, right? Being practical. And some of them do address some very real market failures and market conditions.

Because even if you had a really stiff carbon tax, there's some of these other things you'd want to do. I mean Europe has $8 a gallon gasoline, and they still

have the need to adapt vehicle emission standards.

So, you know, we had -- this is a complicated, and it's almost more of a political question than an economic. But I think what we're doing in California we're appreciating that, and we're trying to work really hard to make sure that all these different policies that we adopt, that they are consistent, if not synergistic.

And I think for the most part, so far, we've done well in that. But as we go further down the road, we do need to be very attentive to this issue, and we do make -- need to make sure we aren't doing things that are costly and counterproductive. And, I mean, that is the -- you know, one thing I tell my students is we really need good people going into government, because this is really hard, and getting it straight.

And you have it not only within CARB, you have it between CARB and Energy Commission, the Public Utilities Commission, Natural Resources Agency. And it's always going to be complicated, but I think it's a good point to make it as simple, as low cost, and as easy to replicate as possible. And we even think the Low Carbon Fuel Standard is an example. We have been thinking about that, how to make it more easy to be either replicated or adopted as we go forward.

CHIEF ECONOMIST WIMBERGER: I will say in the

process of doing the 2017 scoping plan update, we had this one very famous chart that showed the California GDP going up and emissions going down. And I think to the point of the role of California as one percent of global GHG emissions, yet we can be a leader in this space, is well taken, and apparently no pressure for California.

So something that economists also like to talk about is uncertainty. So given that, you know, we just completed the 2017 update to the scoping plan, it showed that we would -- the modeling showed an estimated 45 percent reduction in fossil fuel demand by 2030. What do we do to ensure that we are on the path? Are there things that we can do on the consumption side? Are there metrics that we should be looking at as we go forward that can really help ensure that we're staying on a trajectory that is leading us to our 2030 GHG target?

Or is it all about pricing? I've stunned them into silence.

It's good we have a question. This is a question from the audience. How would a transition from a gas tax to a VMT tax occur? Would they coexist for any period of time?

DR. SPERLING: I've been thinking about this a lot. And I think, practically speaking, they do have to coexist. So one idea -- so at UC Davis at my Institute,

we are doing a study for the legislature on how to deal with electric vehicles with respect to gas -- gasoline prices and VMT fees. And so, you know, I've been thinking about it a lot, and I think -- okay. So here is one path of how it could play out, and that is we apply these VMT fees first to electric vehicles and non-fossil fuel vehicles.

And as they come in, there's more and more of them, maybe, at some point, we can phase-out the gas taxes. But that's at least one scenario of how this might play out, because it is really hard and complicating.

One of the things we think about -- I mean, I'm sure everyone on the panel and many in the audience think, well, if we have VMT fees -- actually, it was brought up, I think that was by Hannah, about how do you use these VMT fees, how do you impose them? And if they're just a straight VMT fee, they disfavor a Prius or a ZEV versus a Yukon. And so how do you -- how much nuance do you start putting into it?

And, you know, working as a regulator here for now a decade, I've come to appreciate how important it is to be simple, but how difficult it is to stay so full. But I think this is a case where we'll quickly want to go beyond just a straight VMT fee, which is what the state of California is now seriously examining. And I think this

deserves a lot of attention, a lot of thought and a lot of research.

DR. KNITTEL: I would be hesitant to actually apply it just to hybrids or EVs at the beginning, because on the margin you're providing a disincentive to buy those vehicles, right? I don't see why you wouldn't just start the VMT tax at one cent -- I'll get the units wrong, but very low, and ramp that up at the same time as you're ramping down the gasoline tax. You could pass legislation that makes it revenue neutral. So for every, you know, increase in VMT taxes, you have to see a one-for-one reduction in gasoline taxes.

DR. LANGER: I'll just add to that though that at the federal level, you know, the gasoline tax is supposed to be covering road expenditures, but we've had to subsidize the federal -- now, I'm blanking on the -- the Federal Highway Trust Fund. So fundamentally, if we're going to -- if we're saying that we're funding roads via gasoline taxes, and we're making cars much more efficient, we're going to need both of them, or we're going to need something else to think about adding on top of that some revenue. Because right now, it's coming from income taxes and it's coming from everywhere else, right? So we might as well fund it directly from drivers.

CHIEF ECONOMIST WIMBERGER: All right. Well,

we're nearing the end of the panel. I wanted to give everyone a last -- if you have a last pitch, a last ploy for -- talk about your latest research, or if you want to think about, or have ideas on what is transformational? So if you had -- if you're giving -- you know, we're talking to policymakers in California here, what is your advice for what the next steps are in terms of transportation, and seeing -- continuing to see declines in GHG emissions, and, if we can, accelerating the pace.

And I'll start with Chris and go down this way.

DR. KNITTEL: Well, I'm going to -- I guess I'm just going to come back to the importance of getting battery costs down. So, you know, I don't if you follow cobalt prices very closely, but if you're in the industry you do, and those are increasing. And you know a world where everybody is buying electric vehicles is going to put more pressure on cobalt, and lithium.

And so I think we have plenty of lithium in the world, but other rare earth -- components of the battery. If you just add up -- and this is again to plug the mobility of the future. If you just add up the ingredients required to go into a lithium ion battery. So before you do any of the engineering, or the cooking so to speak, that's at $90 a kilowatt hour, or thereabouts.

So at $90 a kilowatt hour, you need oil prices to

be about $80 to $85 a barrel for the EVs to win. There's a good chance that we'll never be at that level, so that just points to needing more and more innovation. And maybe the future is not lithium ion, maybe it's some other chemistry. But that's where I think the hard scientists need to be suitably compensated and incentivized to do the research to lead to those technological breakthroughs that would allow us to drive pure -- all of us to drive pure EVs.

MS. PITT: I think I'll reiterate the importance of driving new technology and addressing sort of the risk of technol -- risk and costs of technological innovation. And at the same time, I think that, you know, a shift to electric vehicles isn't -- isn't the whole deal. It's not the golden take, and a lot else needs to happen at the same time to address, you know, the emissions from the fleet on the ground right now. And so I think that's where sort of smart ways to penalize driving from heavy emitters and -- and/or, you know, reward less driving in less emitting vehicles. Sort of smart ways to tax and subsidize and encourage low-emission mobility, and including, you know, thinking beyond just the lines of the transportation sector to -- I think I agree that the housing sector can be a really big part of this in urban planning. I think the connection between transportation

in other sectors is overlooked and perhaps across all sectors.

And, yeah, I think that's -- that's all I've got.

DR. LANGER: So I think I've made my point on housing.

(Laughter.)

DR. LANGER: I guess the one thing I would say is that as the economist, I think it's worth thinking about transportation, the cost of policy in transportation broadly, not just in terms of, you know, a CAFE standard might increase the average cost of a new vehicle, but in terms of access.

You know, access is something that's important for all of us to be able to get where we want to go and do what we want to do. And so we want to think, when we balance -- when we try to balance these policies, we'd like to reduce greenhouse gas emissions, but some things that Dan has said, we potentially want to increase access.

We want to increase people's ability to get where they want to go. And so that requires thinking creatively about people's day-to-day life, not just what's coming out of their tailpipe for each given month.

DR. SPERLING: I'm going to be a little flippant here with my economist friends and say, I love and hate economics.

(Laughter.)

DR. SPERLING: It's like I'll just -- Chris just inspired it in his comment. He says, darn, we get those batteries, and what does it do, it pushes up cobalt prices and makes it more expensive, more difficult. And then we do all this efficiency, and it reduces the price of oil, because we're -- now, there's less demand. And they make it so hard.

(Laughter.)

DR. KNITTEL: We don't make it hard. We just tell you how hard it is.

(Laughter.)

DR. SPERLING: I love economics.

(Laughter.)

CHIEF ECONOMIST WIMBERGER: That's a good last word there.

(Laughter.)

CHIEF ECONOMIST WIMBERGER: Well, thank you to all the panelists. I really appreciate it. And as I said, this will be synthesized and put -- we'll put together a white paper, including some of the comments from the audience. But thank you very much.

We're going to take a quick break, do some shuffling, and then we'll be back at two o'clock with another panel, so stay tuned.

(Thereupon a recess was taken.)

CHIEF ECONOMIST WIMBERGER: All right. We're going to get started.

Hello.

Kind audience members, please take a seat or take it outside. Thank you.

Okay. We're actually a minute early. So I do apologize for that.

So we're going to get started with our second panel. And the title of this panel is examining options to limit production of petroleum for additional GHG reductions. Rolls right off the tongue.

For this panel, we do have a Amy Myers Jaffe who is going to be the voice that you do not see up here. She is remote and will be participating via phone line. We also have Roger Aines from Lawrence-Livermore, Severin Borenstein from UC Berkeley, and to kick it off is going to be Pete Erickson from the Stockholm Environment Institute.

So we're going to start with a bit of -- each panelist is going to get a few minutes to give a bit of an overlay on this topic. And then we'll go into some questions. And again, we do have roving staff with cards. If anyone in the audience does have a question they would like to ask the panelists, please do that.

So, okay, we'll start off with Pete.

(Thereupon an overhead presentation was presented as follows.)

MR. ERICKSON: Thank you, Emily. And I'm going to break the wonderful trend we had of minimal PowerPoints to take us back to PowerPoint for a moment, because I have been doing research over this year on this very question of how limiting oil production in California could contribute to California's climate goals.

And there's a few things I would love to be able to present to set the stage. First of all, if you don't know SEI, the Stockholm Environment Institute, we are a global think-tank focused on the intersection of environment and development challenges globally. We have a number of offices around the world. Our closest one is just down the street in Davis, California. They work mainly on water.

This project was led out of Seattle where I live, because that is where our climate policy group is.

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MR. ERICKSON: So to provide a bit of context to start, these trends and slides should be familiar to folks who were here in the morning session, mainly because they show some things that we already know, and were established then, namely that California oil consumption

has been between 600 and 700 million barrels a year since 1990, even before that actually, and that oil production in that time has declined from between 300 and 400 million barrels to slightly less than 200 million barrels today.

And to give a preview of -- or rather a theme I think of some of the remarks I'm going to make, I think that this decline in production prevents -- or presents an extraordinary opportunity for California and ARB in achieving their emissions goals and broader climate goals.

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MR. ERICKSON: So to provide a bit more just characteristics about California oil - some of this will be new, some of this will be repeat from those here in the morning session - California oil is in, I should say, I think a rather risky position at the moment and going forward.

And that is because of a number of factors that are displayed in this lovely bubble chart. This is from our paper earlier this year -- from February of this year. I'll provide a link. I have a couple copies for those who are interested in it.

The first reason that California oil is in a risky position is that it is very highly greenhouse gas intensive, when you look at the emissions, both from production, to refining, to transporting it, to burning it

and its co-products at the end.

Oil sands in Canada are often thought of as among the world's most greenhouse gas intensive oil. They're about 700 kilograms of CO2e per barrel. Well, much of California's oil is about that level. In fact Midway-Sunset is at that level or higher. South Belridge, Kern River, and other fields are approaching that level as well.

And so if we're imagining a deeply, deeply low carbon transition, we're essentially zeroing out net global emissions by 2050 or within a decade or so after that, I think that's the Paris Agreement goal. And that is, you know, broadly consistent with what California aspires to be consistent with in its own goals, you know, it strikes me as, you know, straining, you know, notions of that agreement to say that high GHG intensive oil is the -- is the oil that should fill that very quickly dwindling carbon budget. That's one thing that suggests that California oil may not be given a favored position in a low-carbon transition.

Another is that California's oil is fairly high cost. We saw earlier that permit or new oil drilling and permit trends really dropped substantially below -- I don't remember what the exact number was, but, you know, $60 a barrel or something. And, in deed, you know, much

of California's oil requires prices higher than $60 a barrel to essentially drill new wells.

Well, $60 a barrel is about the oil price -- lots of uncertainty, but about the oil price that a deeply low carbon transition would see. We would not see high oil prices in a world that's rapidly moving away from oil. So California's oil is at risk for that reason its high cost.

Another is that California oil poses environmental justice concerns by the State's own assessment. In their California EnviroScreen rating, most of the oil in California is in areas that are in the worst -- 60th percentile or worse, that's the light yellow; 80th to 90th percentile is in the orange; and 90th percentile is in the red -- the worst 60 percent or more of pollution vulnerability as judged by the State's California environmental -- environment screen.

So this gives us an opportunity -- it gives California an opportunity to be more intentional in how it manages its oil production. And to begin that wind down -- well, that's already begun, but to purposefully manage it more intentionally for both climate and local benefits.

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MR. ERICKSON: So when we ran the numbers using basically an economic oil market model, as well as a

review of the literature, we found that if California were to reduce oil production by roughly 100 million barrels a year in 2030 relative to business as usual, that would reduce global emissions by eight to 24 million tons of CO2.

Just to give you a sense in the scoping plan, ARB when they list out individual measures across the whole spectrum of the scoping plan, the individual measures are -- and I don't have the number here, but they're on the order of this range. They're something like three to 40 or 50 million tons each.

So this measure -- you know, eliminating oil production would essentially stack up well if you're looking at global GHG emissions.

It also might demonstrate what an equitable phase-out of fossil fuels could look like globally. And this, I think, is picking up the leadership angle that we've heard in several presentations already today. This has both local and international implications. But essentially, if we are looking at an industry that's already in decline, and we want to manage that for fairness to workers, for equity, for the people that live near those oil wells, we could -- California could jump in and really do that in a way that serves as a model for the world, and in creating those economies that are

post-carbon as well.

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MR. ERICKSON: The very specific hook for the Air Resources Board is that it could address leakage. And this is -- again as we've heard, because California is planning so aggressively to reduce oil use that leaves more oil available in the global market for others to consume, that is referred to as leakage. ARB has a mandate to consider leakage, and they could do so by essentially not producing a barrel per each barrel that they don't consume.

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MR. ERICKSON: So Emily, in her list for this agenda, put forward some specific policy ideas for discussion. Our paper goes into those in much more detail. Perhaps given time, I won't describe our assessment of each of those now, but we can get into that.

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MR. ERICKSON: So thank you very much.

CHIEF ECONOMIST WIMBERGER: Great. Thank you, Pete. I think then we'll go to Severin, if you'd like to give some opening remarks?

DR. BORENSTEIN: Sure. Thanks. Pete and I have had a back and forth in blogs over the last week -- or couple weeks I guess, which is I guess why we're both here

today.

So I'm going to start giving -- by giving a few general principles, and then dig in a little deeper. First of all, I think there are a number of considerations we have to remember when we start affect -- talking about California's reduction of greenhouse gases, I think Chris in the previous panel emphasized that we need to find solutions for the whole world. California being less than one percent of world greenhouse gas emissions, our reductions are good. But what real -- all that really matters is if we can create a way -- pathways for the rest of the world to reduce, and particularly for the developing world to reduce, because they are not only more than half of the emissions now, they are on a much stronger growth trajectory.

So we need to develop the technologies and the knowledge that allow them to grow in a way that is on a low-carb -- lower carbon path.

And I think that -- that brings me to the second point, which is climate change is a big deal. It's a major problem. It's not the only major problem in the world. And, in fact, in the developing world, there is a view that it is one major problem, but there are some other also very important problems, particularly growing out of extreme poverty.

So we aren't going to make it with pathways that are expensive. The growing developing economies are not going to accept pathways that cost a lot more money. We really need to develop the technologies and pathways that allow them to grow into thriving economies in a cost-effective way.

The third thing -- general principle is as Pete actually mentioned, we need to stay focused on leakage and the extreme form of leakage reshuffling, where actually nothing changes at all. We just move around the part -- the supply in the world economy. So, the SEI report takes it seriously, and says it is true that other places are going to produce more, if we produce less. They then estimate how much of a gap there would be, that is how much total world production would decline.

I don't quite agree with their numbers, but the principle is right. And they do find that there would be a world decline in oil production if California -- even though there would be some offset, for every reduction of one barrel in California, the rest of the world would increase by 0.4 to 0.8 barrels, leaving a gap there of 0.2 to 0.6 barrels.

I think that's a point well made. But I think when we then talk about greenhouse gas reductions, we have to recognize the primary pathway for this policy to reduce

greenhouse gases is by raising the world price of oil, that is by making consumers worse off and producers better off, as we raise the price of oil.

I think that's a major problem. I think it's a problem for a couple of reasons. One is that politically I think it's a problem, that it wouldn't be very acceptable in much of the country or the world. Secondly, I think ethically it's an issue, because if you look at who the consumers are, they are on average much poorer than the beneficiaries of raising the price of oil.

If you look at where the oil in the world is, the major reserves are Venezuela, in Russia, in Saudi Arabia, UAE, Iran, and so forth. And so that's where the money would be transferred to. If you look where it would be transferred from, it would be transferred from drivers all over the world, including the United States, but also in some very poor developing world countries, including India and China.

So I think -- and so the SEI report talks about every barrel -- or sorry, every ton of GHG emission reduction would cost in income to California, $100 to $300. It turns out if you use their same methodology, it would also transfer about $500 per barrel to the producers from the consumers on top of the actual lost income to California producers.

I think we need to take that seriously. And for that reason, although I am not a climate change denier, as I have been accused of being for questioning any climate policy, and this one included, I think we need to take serious steps. I think those serious steps need to be on the technology and knowledge creation side.

California I have become a much bigger fan over the last decade of investing in smart R&D policies and new development policies. I think that's where we should be focused. So long as California is a major consumer of oil, I don't think it really makes sense to start restricting California's production of oil.

So let me just finish, and I will stop by saying one more thing. There are ancillary benefits and costs to a policy like reducing California's greenhouse gases. Some of the ancillary benefits are that it would also reduce local pollutants. I think that's a great thing, and it should count in doing the analysis. That is reducing emissions of local pollutants, which I think California continues to underprice and overallow and not -- and not impose costs on the producers of those emissions sufficiently.

On the other hand, it would also cause a lot of economic disruption. The costs are not just the lost income to the producers, they're also the job disruption

and the community disruption from shutting down oil production. So we need to take those into account. And I'm fully aware of them, and -- but I think we need to also keep an eye on what the main mechanism is. And I think a mechanism that is going to raise world oil prices in order to force all consumers to consume less and transfer that money to producers is going down the wrong path.

CHIEF ECONOMIST WIMBERGER: Thank you.

Roger, would you like to go next?

DR. AINES: Thank you, Emily. Even the most rapid energy transition that we can envision is still going to have liquid fuels playing a role in California. We heard we have zero -- all ZEVs in 2050, the rest of the gasoline vehicles still have another 20-year lifetime from that point on. So the question that I ask is how can we make those liquid fuels as low carbon as possible, so that the fuels that we do use end up having the least impact?

At Lawrence-Livermore Lab, we think it's impossible to significantly reduce California's transportation emissions, while protecting jobs and air quality by using a thing called carbon capture and storage to reduce the carbon intensity of California oil production.

We can use the state's oil industry to store CO2

that's removed from their operations, but also that's removed from the air and that's a big deal.

We're focused on financially feasible ways to reduce carbon dioxide emissions. Even after we electrify everything, even after we've done all the stuff that we all want to do in the plan that we heard about this morning, the world is still going to need to remove carbon dioxide from the atmosphere. We've already put too much in.

And so I'm very focused on how to get that to happen in the future. And the Low Carbon Fuel Standard is an incredibly important way to do this. This is a brilliant climate policy, because it pays you more to do a better job. You just don't have to meet a limit, as most climate policies do. But in the case, the better you do, the more you get paid. So this leads to technology innovation. And it has led to a tremendous amount.

The California oil industry is a prime source for realizing significant volumes of innovation here, because they have the infrastructure, and resources, and desire, it turns out, to do this important work, because they're listening to this conversation too. They don't want to be put out of business either, let me tell you.

The Central Valley is a great place to do this, because the oil industry there could go from being a

carbon emitter to a carbon absorber. Imagine that we go from producing oil in the Central Valley to absorbing carbon dioxide in the Central Valley.

If we eliminate the California oil industry, we eliminate the opportunity to have that future. The opportunity comes from two main areas. First, the oil industry can reduce its emissions by capturing CO2 from some of these things that Pete showed, all those emissions in Belridge, et cetera. You can capture that CO2 and put it underground.

In the proposed revisions to the Low Carbon Fuel Standard, this is a -- an activity that is incentivized. The oil industry is almost perfectly configured for this. They have the right land, they have the right equipment, and most importantly they have the right workforce. These 150,000 people or so that depend upon the Central Valley's oil industry are also good at putting CO2 underground.

When CO2 was put underground, it's very similar to oil when it's put deep. And you put it -- if you put it in or under the reservoir rocks, then you can expect that it's going to stay there just like the oil has stayed there for millions of years. So we anticipate that the Central Valley is a safe place to store CO2 for -- to permanently store CO2.

To date, the United States has developed

technology and demonstrated it. We put about 14 million tons of CO2 underground, 14 million, just in experiments. It works. It's safe. And worldwide, there's 20 projects and operations gaining experience and engineering standards.

When we look at the money on this, we -- it looks like about $100 a ton is more than sufficient to incentivize significant adoption of carbon capture in California. And that would include the carbon -- the Low Carbon Fuel Standard price and the 45 Q federal tax credit. So, in fact, there's plenty of money on the table to do a lot of carbon capture in California in the oil industry.

Of course, changing to renewable energy in the oil fields is also a great way to reduce their carbon footprint, and that's also incentivized in the LCFS.

Second, and perhaps most exciting to me, is there's an opportunity to combine better biofuel production with C02 storage in the oil fields. What am I talking about there?

Typical biofuel production when you put a -- make a molecule of biofuel, a molecule of ethanol, you also emit a molecule of carbon dioxide. Half the carbon goes up in the air as carbon dioxide.

Why? Well, right now, we count that as carbon

neutral. We say, oh, it's carbon neutral. It doesn't matter. But we don't have to. If we captured that CO2 and put it underground, it would remove carbon dioxide from the atmosphere. That's a big deal.

And the CO2 was really easy to catch from ethanol and biogas plants. Currently, if we took all of the biomass that we had in California, which is about 38 million tons of biomass, things like almond shells, and sewage waste, and things like that, converted that into about -- it turns out it would turn into about 38 million barrels of transportation fuel, and about 38 million tons of CO2. That's kind of magic how that works out, but that's how it is.

And so if you converted all of our biomass into biofuel, you'd also have 38 million tons of CO2 that you could put underground in or under the existing California oil fields.

Well, what are the limitations to doing this?

First, we need a safe storage location established. The Central Valley looks pretty good to do that.

Second, the central -- the CO2 has to be accumulated from all these different sites. If you make biofuel, you make it in fundamentally small facilities, and so you have to accumulate it. And while it would be

nice to have pipelines to accumulate that CO2, that's probably not how you're going to start. But it turns out that you could use trains. The trains are well aligned with where the facilities are and where the potential storage sites and the oil fields might be.

And so you accumulate this CO2, transport by it train, until such time as you built the pipelines and established that it's really what you wanted to do in the long run.

An important element is the regulatory environment for doing this. We all know that the California regulatory environment is pretty complex. Today, there would be federal, state, and local authorities associated with controlling this kind of underground activity.

The Department of Conservation and CARB are both important players in that, and we've heard from both of them today. The federal EPA currently has the regulatory oversight on that, and it's called a Class 6 well oversight. That's an activity that California could ask for primacy on, and thereby simplify the overall regulatory environment, so that California had complete control over the regulation of this carbon capture and storage activity.

As we've heard, another act -- another issue is

air pollution, local air pollution. And, in general, carbon capture can reduce criteria pollutants, because it simply captures SOx and NOx, at the same time that it captures carbon dioxide.

However, if we talk about accumulating CO2 from multiple sites, you're probably talking about increasing transportation emissions. And so that's the thing that has to be carefully considered. And any systematic study of carbon capture in -- for this purpose has to consider the effects of transportation on air emissions.

In the long run, the only way to remove carbon dioxide from today's over-polluted atmosphere is to put it underground. And the Central Valley is going to be a great place to do that. We can start doing it now, and reduce our carbon emissions, reduce the carbon footprint of the fuel that we use. And in the long run, when we're no longer using fossil fuels or rather perhaps the last few barrels of fossil fuel, we could be having carbon neutral petroleum from California, because we're offsetting it with the carbon -- the carbon dioxide that we're putting underground, and at the same time removing carbon dioxide from the atmosphere, transitioning the job of California oil industry from an oil producer into a carbon dioxide remover.

Thank you.

CHIEF ECONOMIST WIMBERGER: Great. And we're going to go from underground now to the voice in the sky, Amy Myers Jaffe and the Council on Foreign Relations.

Amy.

MS. MYERS JAFFE: Hi. Thank you for this opportunity to present. Sorry I couldn't be there in person. I'm going to try to break it down into several different categories. It turns out, now that I see what the panel is talking about, I've done, you know, two decades worth of modeling on global oil, and also more recently in the last five years on the California markets and alternative fuels itself. So I preface this statement -- I'm always hesitant to criticize the model, because they're the best tools we have, but I really really, really want to emphasize the fact that the oil market is very unpredictable. The idea that you're going to have a computer simulation decide arbitrarily what you think Saudi Arabia would do if it's suddenly had the opportunity to put 600,000 barrels a day of heavy crude into the market. I think it's very unrealistic to think you could model that with a computer.

If tomorrow we closed our production down, there's no question in my mind that Saudi Arabia could just take market share. And if they didn't take it, maybe the Russians would do it. And if they didn't do, maybe

Iraq would do it. The idea that we could somehow predict what the market reaction would be with any precision or we could somehow calibrate a model to tell us how much oil prices will go up and down also not probably likely.

And I refer the group to the Boston Consulting Group study, which I was involved in peer reviewing about all the refineries that we're going to close in California based on their very good model, based on the Low Carbon Fuel Standard, none of which has happened.

So I just want to caution everybody, you know, models are very instructive, but we also have to, you know, go beyond to the broader literature about how oil producers act in the market, which is extensive, before we would actually, you know, consider a study completed.

Now, the interesting opportunities, I think Roger, you know, has mentioned some very interesting opportunities. And I'd like to offer a perspective on the oil and gas industry.

California, in my opinion -- and I served on the steering committee of the California Council on Science and Technology's 2016 study on drilling techniques used in California. My opinion is that California does not properly regulate the industry. And I think people in California would be surprised to hear that there are regulations that are in place, in places like Colorado and

Texas, that are stricter than California in many important regards.

We allow wastewater to be put in unlined pits. California allows flow-back water from oil wells to be used and reused on agriculture without prior treatment. We don't have any studies or regulations on norms. These are things like uranium and radium that have been found to pollute water in Pennsylvania.

So the first step, since I have a platform, you know, we also need to look at water. But I agree with Roger that a lot could be done on methane leakage. My estimates are that 13 million metric tons of the CO2 emissions, so that's about, you know, 80 percent maybe a little higher, that come from oil and gas production in the state are partly because we use steam generation because it's very costly and difficult reservoirs to do enhanced recovery. And if that steam was generated with clean energy, you know, solar or so forth, which some people are experimenting with, that would go a long way to reduce emissions. We need to have and implement strong methane leakage policies.

And if those things raise the cost of the production, then, you know, for Peter's edification and pleasure, I'm sure that would reduce the investment -- future investment in oil and gas in California, because it

is a very expensive barrel.

But that said, there are other things that I've looked at that I think would be much more effective, because there's no guarantee that if we shut off our oil production, it wouldn't just be replaced by someone else. I just don't really find that a convincing argument. And if we really actually wanted to raise the price of oil to get people to use less of it, there's just a very simple way. That's called taxing its.

So, you know, if we want to set an example, then we should stand up and put a higher tax on fuel, and then give some kind of money back to people who are disadvantaged in their fuel purchases. That is really the best way to raise the price of oil is to tax it.

But that said, road freight movements are seven percent of California greenhouse gas emissions, as Dan Sperling mention earlier. There are a lot of different things that could be done. We do not have an effective landfill policy in California. We did a model where we found that over six BCS a year could be converted to renewable natural gas from landfill, and put into trucks. With more incentives or more regulation, that could be a higher volume. We don't have actually a tipping fee policy in the state of California. We haven't gone as far as Europe, which now bans landfill, so -- because, you

know, the methane that leaches out of all the landfills in the state, you know, is lot of methane. So that's another area where you get a double good. If you're taking the methane that would be just going up into the atmosphere and you're using it to replace fossil fuel that would also be burned and going -- put carbon into the atmosphere. That's a two-fer.

So but the other two things that I have modeled recently, I have paper come out with some (audio went out) are two different things. One is to have city set places that are car-free zones, and that do not allow -- could either -- be don't allow vehicles that -- personal automobile vehicles at all or could be just banning IC engine vehicles. And that is something that again Trump administration can't intervene on. It's inconvenient, but is it really inconvenient. I mean, if there's park and rides from the BART, you know, for those of us who've actually sat in Bay Area traffic, maybe if somebody forced me to use the BART, that would have been a better thing.

So -- and the other one, which I know the State has looked at, if you want to send message to the car companies, and you don't feel that they are producing the right vehicles -- and I can tell you as a person who lived in California, and went shopping for an electric vehicle, in the last couple of years, there's really a pretty thin

market. So I'm a professor, so not wealthy enough to have a Tesla. And, you know, it's pretty hard to find another kind of vehicle that could work for the needs that I had for driving and not having to have four different cars.

So, you know, in China, there's 100 different models of electric vehicles. They are making a lot more progress than California.

So we've modeled what would happen in places where Europe has announced that it's going to have an internal combustion engine ban starting in 2040. I think we -- if you look at the experience of diesel, the problems with diesel fuel in Europe, you find that consumers switch pretty readily. I very much agreed with Chris's comments about behavior. And I think a IC engine ban, even if it's very forward dated, sends a signal to the car makers, both international and domestic, that California is serious about getting those vehicles off the road.

But I like some of the other suggestions as well, but I've modeled those to car-free zones, and IC engine bans. And I can tell you that would probably be much more effective than shutting down oil production any particular place, given the fact that it would just, as people discussed, shuffled to some other place. The best way to eliminate emissions from transportation or oil use is to

lower demand.

So anyway, I look forward to our discussion period, and can answer any questions on the specifics of some of the research we've done.

CHIEF ECONOMIST WIMBERGER: Great. Thank you, Amy. I think we had a lot of really good points that were brought up. And hopefully, we will have time to cover all of them.

I wanted to start out with a theme I think that was pervasive in everyone's comments about the scope of the problem. So we're facing -- we're talking about a California issue. We're also talking about impacts to local communities, and we're talking about a global oil market, and leadership on the global scale with a greenhouse gas, which is a global pollutant. So I wanted to get a sense from the panelists how do we -- how do we sort of rectify all of these different scales and scopes, and how do we think about the impacts of California both in terms of leakage, but also sort of looking down to the impacts on local communities? What do some of the proposals that you've discussed, both in terms of CCS on different moratoriums, with new well permits on production in California? What are the impacts across sort of that scale on, you know, sort of local, state, and federal, and then I think globally?

MR. ERICKSON: I guess I see that bringing supply and demand together could be a real unifier across scales and across issues. And the reason I think that is partly because of the leakage question. I mean, as Amy pointed out, just how much leakage there would be is uncertain.

Nonetheless, regardless of how much there is on the demand side, moving -- pulling the same amount out of production, essentially by definition, eliminates that leakage. So because of the -- you know, it has many co-benefits too, including the co-benefits of focusing on environmental justice and bringing -- reducing other pollutants that come with oil production and combustion for that matter.

MS. MYERS JAFFE: I think if we want to regulate pollution, we should regulate pollution directly. And, you know, we -- I have that same issue with biofuels, where, you know, people from the mid-west come to me and say that they -- they need this, you know, process for jobs. And, you know, let's not confuse jobs with air pollution. We need to have policies that are directed at one thing, and then we need to do a cost benefit analysis of how they affect jobs or income disparity.

And if there's a policy that -- I'm going to speak like an economist now. You know, if there's a policy that there's an externality that is not being

assessed in the market, and it's causing undue pollution, it doesn't mean we can't have a policy about that pollution. And to the extent that that policy would be regressive, then it needs to be addressed in some additional way. And that could be through taxes, that could be through taking more of the money that comes in through cap and trade or some of these other regulations and directing that money to lower income communities.

You know, I know a group that's doing very good work putting in community-scale solar in one or two or three or five low-income communities. But a much more effective way to achieve that would be if all the cost savings from low-cost renewables was not allowed to just go to the corporation that put it in at their data center, but that that benefit was spread across to all ratepayers, including low-income -- maybe at a higher proportion of low income ratepayers.

You know, it doesn't matter where the solar panel is, you know, you can give the benefit to low-income communities, and then low-income communities would see that there's some benefit to clean energy for themselves. So I really think it has to do with equity, in terms of how we determine spending, how we determine tax policy. These things are a broader element. And we don't have to say, well, we're not going to stop pollution because it

might hurt low-income people. We need to look at how we create an equitable system for pricing of energy that does not disadvantage low-income people in other ways.

DR. BORENSTEIN: If I can chime in. First of all, we have to be clear. California consumption as we saw this morning is going up, not down. That I think is the fundamental problem here, which is that world consumption is going up, not down, when it comes to petroleum. And California cutting its supply is not going to change that very much, particularly with the continued innovation that's going on on the supply side in the oil industry.

The estimates that we would see $60 a barrel oil with the decline of -- if we reached 2050 goals of -- I'm not sure exactly what the goal is, but I think is really wildly optimistic. I think more likely is if we take a significant share or -- out of the consumption of oil, the price of oil will crash. $20 a barrel is a much more reasonable number to be thinking about and $1 a gallon gasoline is a much more reasonable number at the wholesale level to be thinking about, when we start really putting downward pressure on the demand for oil.

And for that reason, I think it's just not realistic to think that we're going to get there by restricting California supply, or by some sort of club of

supply restriction. I think that we're going to have to do it by creating technologies that can beat oil and that can beat cheap oil. That's a really tall order or we're going to have to do it by solving the problem on -- at the back-end, by taking that CO2 back out of the air.

But those are both real huge challenges. But I think that when we look realistically at the full economic system in which oil operates, that is the harsh reality. And so we need to face up to that and work through the full implications of all of these proposals, and think about things that are actually going to move the world to an endpoint where we can actually get the developing countries and the poorer countries of the world to still grow economically, but to do so in a low GHG way.

DR. AINES: So I want to finish this discussion on a different look. I'm the only technologist on the panel. And I think in terms of scale, in terms of how do you get enough technology out in the field to do the jobs you want to do. And I don't believe we have it yet today. And when economists - pardon me, all economists of the previous panel - look at these things, they tend to think what's -- what exists today, let's apply economic models to what exists today.

My world is to say what you need to make tomorrow, so that we cannot have those outcomes that the

economists predicted. And the most important thing for that is to incentivize businesses to make money trying these things out. I live at the base of the Altamont Pass. Thirty years ago when I moved there, it was fully o clattering tinker toys that weren't making any money making electricity, as wind turbines, but people learned how to do it. Today, it's full of elegant beautiful machines that make money the day they go up, because we had 30 years of learning that was subsidized heavily by government spending. And things like the Low Carbon Fuel Standard could be doing that.

And as I think about scale, that's what I think we need to do is to think about how do we get those companies, and the technology -- it's not just universities, but it's people that go out and do it -- to make those things happen.

MR. ERICKSON: If I could respond to a couple of Severin's points that addressed our paper. I think there's -- Severin is looking at the reduction in supply in isolation, but this wealth transfer argument doesn't really play out, in my view in the way that he describes, if you look at both supply and demand reductions in California together.

As we heard this morning, California is planning on reducing oil demand by 150 million barrels or so per

year. And if you do that, I mean, that's taking wealth away from all oil producers. So to, you know, essentially add a little of it back by restricting production, you know, in net, there is no wealth transfer. So I'm not sure I see the issue there.

The other, I guess, more specific math issue is that I'm -- in our work, we've been counting the cost of a production cut as the lost profits to oil producers in California. Severin is adding on an estimate of the increased profits to oil producers elsewhere. One of those is a negative sign, the other is a positive sign. If they both count as costs, that seems a little strange. But if you add them together, then, you know, either one is a smaller number.

So I think that the wealth transfer argument is a bit of a distraction.

DR. BORENSTEIN: If I can respond?

MR. ERICKSON: Please.

(Laughter.)

DR. BORENSTEIN: First of all, the wealth transfer from reducing supply occurs whether or not demand goes up or down. So if we reduce demand, that would be great, and it would still be an additional wealth transfer to producers if we also reduced supply. I'd be much more sympathetic to that if California were a net exporter of

oil. We are a gigantic net importer of oil, and we are going to become a more and more net importer of oil, because California production is declining.

Second of all, yeah, I do actually put a different weight on the cost -- on the income of producers in California, who are creating California value, and value to the California economy than I do put on income to the Saudi Arabia royal -- Arabian royalty or the Russian oligarchs. I don't think that's that controversial actually, but I think that we should be viewing it that way.

So I think that the wealth transfer really matters, and we need to -- but I -- from a ethical point of view, but I also think it matters from a political point of view. The reality is a policy that raises world oil prices is ultimately not going to be one that is going to be popular in the rest of the world. We aren't -- it's not going to be popular with the poorer countries. And it ultimately is not going to be one that is going to lead us to where we need to go, which is getting off oil.

Because if you raise the world price of oil, you make it more attractive to look for oil. You make it more attractive to develop the technologies to extract oil. So ultimately, we're going to need to make it less attractive, and we're going to need to make it

unattractive to produce oil in California.

And here's where Pete and I, I think, are very much on the same page. Ultimately, what's going to have to happen is the price of oil is going to have to go down, because that is what happens when we take the demand for oil away. But when that happens, these California oil producers are going to stop producing of their own accord. And, you know, one of the arguments Pete made was, well, we're doing them a favor, because we're going to cut off this new investment, which may not be economic anyway.

You know, the oil companies are pretty good at doing that analysis. They may -- we may disagree with them, but they're doing a pretty rational analysis of how much money are we going to make extracting -- doing the investment to extract new oil. They think it's a winner. I hope they're wrong. I hope they lose their shirts on it, but I fear they're right. And if I'm -- and if they are right, what we're doing by restricting California supply is sort of a drop in the bucket on the supply side, a big wealth transfer and a distraction from the real focus, which is developing the technologies that ultimately drive oil out of the energy industry.

MR. ERICKSON: All of which are aided by high oil prices.

DR. BORENSTEIN: No. Driving oil out of the

energy industry is -- does not happen --

MR. ERICKSON: EVs, as we've heard, are driven by hire oil prices.

DR. BORENSTEIN: -- by making it more attractive to invest in oil supply.

CHIEF ECONOMIST WIMBERGER: So I want to take a tread of both of those comments on the wealth transfer, and we have an audience question talking about equity. So the comment is there have been no EJ voices all day. We have our own scientists as well. EJ, by definition, means we speak for ourselves. So what can each -- what is the opinion of the panel, what can we do to be better bridges to our communities in California, and I would add on to that in communication? And then also, what is the impact to Californians of this potential wealth transfer regionally, thinking about employment, thinking about impacts elsewhere?

DR. BORENSTEIN: Well, I would say -- I'm certainly not a communications specialist, as I've already probably shown. But I think the EJ community has been very active, and does a good job rightly of pointing out the impacts on these communities that have historically been under -- under-recognized and underserved. I would like to get more on the same page with them of actually forcing more local regulation even before you hit these

limits through taxation of local pollution, for instance.

But I think that keeping -- I think they've been very effective in keeping that aspect of this in play, and it's an important aspect of it. I do want to point out though that when we move oil production to another part of the world, there are some local people there who are also impacted by it. So it's -- while I think we should put more weight on the California impacts, we shouldn't ignore the fact that all oil production creates local environmental hazards.

MS. MYERS JAFFE: And I think I get back to my initial comments, which is that the industry is not actually fully regulated. And there are other places where air pollution restrictions on the use of diesel engines and trucking are stricter. They're in places where -- for certain, there are places where restrictions on water are stricter. And I think that a lot of times what happens is that the politics of the jobs in the Central Valley overwhelms what's needed to be done for people who also live in those places or live -- I've, you know, looked at people who live around the ports.

I mean, the air quality and the health consequences of truckers idling in line at the ports every morning, which is a policy driven thing that we -- California requires that they have to be so many miles

away from the port to stay overnight, and there's no -- and so therefore they have to get up in the morning and stand in line. And the consequences of that on those communities is dire.

And so I do think that a more thoughtful evaluation of the environmental fallout on communities, who pays for that liability, you know, I think has not been fairly assessed. And so I do think that sometimes in the passion on the climate change topic, we lose site of what happens in communities just from basic industrial operations and pollution on top of who suffers the consequences for the consequences of climate change, whether that's fires and other things.

And while I'm grandstanding, let me just throw out that with all the climate assessments that have been done in the state of California, more attention needs to be paid to the flooding and fire risk to major fuel production and transportation systems, because it is my opinion that there are major complexes in the state that are at -- in very high risk areas, and it's not clear to me that the state is doing enough to make sure that the people who live around those facilities are safe.

CHIEF ECONOMIST WIMBERGER: Great. Thank you. I want to pick up on a theme from the first panel, which was about market failures. So in a world in which we're

looking for additional reductions in this space - and Roger, I'd look to you for this - what are the other market failures, aside from the externality of pollution, and in a world in which we have carrots and sticks, what do you think is most appropriate to address those market failures?

DR. AINES: In terms of what are the best carrots and sticks?

CHIEF ECONOMIST WIMBERGER: Yes, and for which pieces, for which failures? Do you see other failures aside from just the externality of pollution in terms of R&D or innovation? Are there other things that we need to address to really try to expedite additional GHG reductions in this space.

DR. AINES: You know, I think that the primary problem here and -- is that we haven't spent enough time developing these technologies and approaches that we talk about doing, and they're expensive. They're gigantic expensive activities. And so we don't have a good understanding of that expense, which translated as uncertainty. And uncertainty is always difficult because it's easy to pick up the high side of the range, and say look how bad it's going to be. We saw this with the LCFS when it was first rolled out. That's the primary one that I would identify.

DR. BORENSTEIN: So I agree with Roger, I think the knowledge creation market failure -- so in all industries, we have this sort of market failure that you make some sort of investment in creating new knowledge usually research and development, and we protect that intellectual property with patents and trademarks.

We have that here too, but I would argue this is an area where we actually want the intellectual property to spread quickly. And patents are actually designed to do just the opposite to restrict the spread so that the inventor can make money.

So here's an area where we actually need this knowledge to be created, and very rapidly dispersed to the developing world where you're going to make very little money at it, because they have an alternative, and it's an alternative that creates a lot of greenhouse gases, but those greenhouse gases then harm us. So there's actually benefit to giving this information this knowledge away to the developing world.

So for that reason, there's an extra reason for the government to be supportive of new knowledge creation. And for that reason, I think that we should be very focused on creating technologies that can be exported.

That said, I also think that we need to be very cognizant of technologies that aren't going to get us

there. Corn-based ethanol is going to maybe drive down GHGs a little bit, but it's ultimately never going to solve the problem. The idea that we still have a program that is subsidizing corn-based ethanol, I think doesn't really make any sense.

I would -- and I think Chris referred to our lunch-time discussion. I would very much like to see the LCFS refocused to focus on real low-carbon fuels, rather than corn ethanol. And I think that's true generally in California policy. We should be focused on developing these new exportable technologies and knowledge, not just technologies by the way, things like running a grid at 50 percent renewables is a challenge. We're creating a lot of knowledge doing that in California, and that knowledge is being exported to a lot of other grids. We are creating a public good, a public value, and I think we should very much be doing that. That's where our focus should be with California GHG policy.

MS. MYERS JAFFE: Let me weigh in and say that I agree 100 percent, 200 percent with everything that Severin just said. And we should absolutely -- it's so questionable whether corn ethanol has any benefit whatsoever, so I'm not going to go through the literature or the debate on that.

But the idea that we have a major policy of the

Low Carbon Fuel Standard that just allows the shuffling of ethanol, that's a disgrace. It should really be doing what it's intended to do. And I will tell you in other states where they have forced the industry to lower or capture methane leakage, it's lead to very interesting new technologies, whether those are lasers, or drones, or, you know, optimal -- optimal sensor technologies that we will be able to sell to other countries, so that they capture their methane from oil and gas, and other kinds of production active -- you know industrial activities.

So that's a big area. A hundred percent agree that to the extent that Cal -- the more successful California is in adding renewable energy to its grid, and coming up with software, and other kinds of management technologies, better inverters and so forth, and automation, that makes it easier and easier over time to have a higher percentage of renewables coming into the market. California could be the leader, because Germany did not do a good job in how to price renewables, so that the benefit of renewables goes across the entire rate base and not just to the actual installer of that renewable, right?

And we have a unique opportunity. The State is -- could be very leading. I know how Hawaii has, you know, got a more ambitious agenda, but it's a unique

situation in Hawaii. California has this unbelievable opportunity to do this correctly. We're positioned with battery storage. We have alliances. We could have alliances with space that have hydro. A lot of interesting things could be done, and we should not sell ourselves short by allowing companies that have tried to close down solar in favor of coal assets in other states to dictate the -- to have the potential to weigh in on the governance structure for how we go about these ambitious goals on renewables.

CHIEF ECONOMIST WIMBERGER: Well, I think we have some clear Team Dan and Team Chris on panel two. Pete, do you have any thoughts on market failures in this space and incentives versus sticks?

MS. MYERS JAFFE: Are you asking me?

CHIEF ECONOMIST WIMBERGER: No, I was asking Pete. Sorry, Amy.

MS. MYERS JAFFE: Okay. Sorry. Go ahead.

MR. ERICKSON: I'm thinking about Severin's point about oil prices, you know, whether -- whether overproduction of oil -- I'm going to sort of restate something that Severin said, whether overproduction of oil, is that a market failure or is that likely to take care of itself in a world where we have, you know, $20 a barrel oil? We don't have $20 a barrel -- a barrel now,

and companies are investing in producing more oil. And when there's an oversupply of oil, we consume too much oil. We have too many CO2 emissions and we blowup past our climate goals.

So there's a very real lock-in risk in terms of this mismatch of timing between the ambition of our demand-side policies that I fully agree with Severin, if they were as ambitious as they should and could be, we may not need to think about supply, but that is not the world that we live in right now. The focus of this workshop is on increasing ambition and on putting options out there to enhance ambition. And so in that world, but the world where we still want to meet our climate targets, looking at supply, I think, still makes sense.

DR. BORENSTEIN: Can I just say that if you take that view, there are big wealth transfers, because the price remains high. And you are -- you are transferring very -- you made the point earlier, that if we really make progress on the demand side, you don't have those big wealth transfers. I hope we do make progress on the demand side, but if we don't, there are big -- there are going to be large wealth transfers.

MS. MYERS JAFFE: And let me just say, you know, just to be contentious, we have a very unstable Middle East today. We have an unbelievably unstable Venezuela,

and you have other kinds of problems for national oil companies in countries like Brazil and in North Africa. And those geopolitical problems are going to have a lot of force on what happens with the price of oil in the coming years. And that might, you know, counter-weigh or not, depending on what time they happen and what else is happening in the regulatory framework.

Yeah, I just think that it's really a critical mistake to set your policies based on some -- whether it's the DOE model or some private model on oil prices. Oil prices are going to be volatile, and we need to set policies that are resilient, whether the price of oil is 200, whether the price of oil is 20, because we're probably going to see both prices in the coming year up and down, up and down.

As we eliminate demand, prices might go down, then that could cause, you know, a higher demand, which causes a shock again. We're not going to eliminate the cycle in the next ten years, and we need to take strong action in the next ten years.

So my advice to ARB is you need to move away from oil price predictions as the sole metric for making policy. You need to have robust policies that use tools, whether they're market-oriented tools in terms of carbon pricing or whether they're regulatory tools in terms of

saying that certain kinds of vehicles can or can't be used in certain geographies, or other things that are much, you know, setting the path for freight and freight deliveries, taxing certain kinds of -- as Dan mentioned, you know, a certain kind of single-use services that enhance the use of gasoline.

And we need to be thinking, you know, very creatively about how to avoid, you know, technology having a dystopic impact instead of the opposite.

CHIEF ECONOMIST WIMBERGER: Great. Thank you. I often joke that if people at ARB were good at predicting oil prices, they would not be working at ARB. They would be doing something else that was slightly more lucrative.

I have an audience question that is for Pete. If California reduced the GHG intensity of its oil through CCS and solar steam production, say to the point where it was the same GHG intensity as Saudi Arabia, would you still conclude that California should reduce production?

MR. ERICKSON: Well, so the emission reductions that we estimated were independent of the emissions intensity of California's oil relative to others. We, in our basic calculations that I put up on the screen, just assume 400 kilograms per barrel based on the carbon that's in the oil. So I guess the argument to limit supply, as I've laid it out, is not dependent on California's oil

being highly GHG intensive.

I think that is an additional consideration. It's actually roughly of the same magnitude if California was to bring the GHG intensity of its oil down from an average of 630 or something kilograms per barrel to something more like 500 or 550, the global average, so say we're cutting off 100 kilograms per barrel across, you know, 100 million barrels, that's ten million tons a year. So that's substantial. That's worth doing, but it doesn't -- it would still be an added benefit to reduce production in global terms.

DR. BORENSTEIN: Can I add one thing?

There is also an accounting issue if California were to reduce its oil production. The idea behind this SEI proposal, and this -- I shouldn't -- this is many people's proposals of reducing California oil production is to raise the world price of oil, and therefore reduce consumption everywhere in the world, and that California would claim credit for that, so that would be how California reaches its GHG goals.

Think for a moment about how you then have a discussion of the GHG production of every other country, and you tell them you don't get to claim credit for those GHG reductions that you are driving less, or buying more fuel-efficient cars. California gets to claim credit for

that. That doesn't count in your accounting. I think that would be a tough argument to make.

And, in fact, I think we would almost certainly lose that argument with every country that would say we're claiming credit for that. And in the sort of global negotiation process, I think we at least need to recognize that it would be tough to not end up double counting that.

MR. ERICKSON: I agree but I don't -- but we haven't proposed that that be an accounting per se that adds or subtracts from anyone's individual account. It's a parallel accounting.

DR. BORENSTEIN: And that's fine. I just think that if Cali -- in that case, California shouldn't count it as reducing -- reducing our greenhouse gas emissions. It's -- it would reduce world greenhouse gas emissions, but we should recognize that every other country is going to count it towards theirs.

MR. ERICKSON: We could have a long conversation about that one.

(Laughter.)

CHIEF ECONOMIST WIMBERGER: Okay. We have another question from the audience. Under the policy suggestion of limiting expansion of California oil production activities beyond the current size, that would be part of sort of a managed decline in California

production. Are there risks of allowing the decline of the direction in California to be unmanaged? Are there lessons to be drawn from the decline of the coal industry, errors there that could be avoided here as we think about a transition away from petroleum?

MS. MYERS JAFFE: Let me take that one on. You know, one of the problems we have in the United States and globally is that there's not sufficient transparency in disclosures about climate risk. Just wrote a like 25-page paper on that in the Journal of Energy and natural resources law together with Paul Griffin who's at University of California at Davis if anybody wants to have another top -- hearing on that topic. I highly recommend Paul. He's probably the world's expert on the topic.

So, you know, part of the issue is if there is a producer in California where that company, perhaps a smaller company, has their California production as a high percentage of the profitability of that company, and as Severin joked suppose they're wrong about global oil prices, or suppose they're wrong about the carbon intensity and the future of their output, which is highly conceivable to me, and they have not disclosed those risks as being material to investors, then investors might be continuing to provide capital, and that capital could be at risk.

So that could be, you know, a pension fund, that could be others. So I do think -- and I know that California legislators and the insurance industry and so forth have looked at this. One does really need to look at the investment-related risk of climate change and carbon on public companies.

And I would say that, in my opinion, as a actual veteran oil and gas analyst, that probably companies are probably too optimistic about the fate of California production perhaps. I do think, as that Severin mentioned, it's very high cost production. It's enhanced recovery. You see companies like Chevron and some of the larger companies are shifting away from high-cost resources. We've seen that in Alaska. We're going to see that more and more over time as unconventional become more economical. And if market demand shrinks, then investment will probably, you know, move naturally out of California as has been suggested. This is very high-cost production.

DR. AINES: I'm a geologist, and I know that everybody thinks about oil in terms of rich people and oligarchs. And I tend to think about it as the mechanics out in the field driving a truck, and he's got a good job. And we saw in the coal industry what happens when you ignore the fate of those people.

There's a political backlash that those of us

that care deeply about climate really underestimated, the idea that you could retrain these people or move them to where there was another job ate our lunch. It doesn't work that way. You can't ignore those people. You can't pretend that 150,000 people who depend upon the Central Valley oil fields for their employment are just going to find something else to do, and it's not going to come back to haunt them and us.

So I think that's a really important thing to keep in mind is that we have to arrange for a transition that is fair and equitable to those people as well.

MS. MYERS JAFFE: I would agree with that 100 percent

MR. ERICKSON: As would I. I'm not sure about the hundred thousand figure. There's a recent report from Synapse Energy Economics that puts the statewide total at 20,000, which is already in decline because of efficiency and other gains. But, I mean, the risks of the coal -- where the coal industry has gone, I completely agree that they're very instructive. I don't think that that means that we shouldn't be planning for what could be inevitable decline of these industries anyway. I mean, the coal industry is in decline not for climate reasons, but for others.

And, you know, regardless, we need to phase out

fossil fuels in the long term. And if we don't, I mean, there are going to be other liabilities that are left to taxpayers as well, if we don't do this right. The coal industry, both in mines and in ash ponds, for example, has enormous liabilities outstanding that are -- may ultimately fall to public hands.

One of the benefits of getting out in front of this issue for oil, and -- I mean, kudos to ARB and others for having this conversation, but is that you can actually plan for that ahead of time, if you do it right. And, you know, there are jobs in clean up. Lots of them, right? Many estimates -- well, at least, for example, in -- in Canada, the clean-up liabilities are essentially ten years of full employment for the whole sector that's in oil.

So there's lots of potential work out there in clean up. There's a lots of potential work out there in carbon storage perhaps that may not depend on oil production, but that can use the highly skilled workers that have made their careers out of oil, because we do need to treat those people with respect and dignity.

DR. BORENSTEIN: If I can add one thing. I think this is another argument for putting emphasis on technology development, and knowledge creation, because the backlash in coal was certainly a perception that it was government regulation reducing the ability of certain

people to continue their line of work.

Now, I say -- I have to be cautious here, because it was, as you said, largely the perception and the reality was cheap natural gas. But to the extent that an industry is destroyed by a more effective low-cost industry, I think you see much less of a political backlash.

Rochester, New York used to be the home of Kodak, and was largely wiped out by digital cameras. And we didn't see a political backlash. Apparently, there was a brief period of Kodak lobbying to slow down the growth of digital photography, but that didn't work.

But, creation of new technologies I think has a much stronger political momentum to wipe out GHG emissions than regulations that are just going to raise the cost. And, you know, I'm an economist. I'm all for pricing externalities. I think that's important, but I've now seen enough of the political process, that I realize that if that's the primary mechanism that starts pushing fossil fuel industries to close, we are going to see a huge backlash that the government is killing my job, rather than we're pricing bad that you were doing to your neighbors, and that's a logical thing to do.

So I think pushing forward on technology has that additional value of being able to move politically with

much less backlash.

CHIEF ECONOMIST WIMBERGER: Thank you.

So I'm conscious of the time. We want to allow for enough time for public comment. I'd like to give each of the panelists a few minutes to sort of summarize. You know, what do you see as the future in getting additional GHG reductions from petroleum production. You know, you can summarize what you've said here, or if you have new ideas. I guess we'll start with Pete.

MR. ERICKSON: Well, I think we've had a great discussion today. And I would love to have time to go more into the CCS question, because I think that some how ended up getting the short end of the stick. Maybe I'm partly to blame for that.

But, you know, to the last panel, Emily, you posed a question, what is transformational? And, you know, this panel is about that. Well, this day is about going beyond in terms of California's ambition as a leader and in reducing emissions globally.

And, you know, kudos to ARB for convening us, because I think for California to talk about this issue of supply, to talk about it as a climate issue, that is potentially the start of something very transformational. And, you know, regardless of what path you choose to go, I think a very important conversation to have in California

is to plan for an equitable phase down of oil production over time, because we're already heading that direction as we've seen, whether it's seven percent per year, as in recent years, or, you know, 10 percent per year as it might be without new permits. That is the direction. And people's lives are going to be impacted.

Let's do it in a way that is equitable, that considers those local impacts, and that also maximizes the benefit for the climate. So I think that's the discussion worth continuing.

Thanks.

CHIEF ECONOMIST WIMBERGER: Great. Let's go to the voice in the sky, Amy.

MS. MYERS JAFFE: So I guess I would emphasize, which I think ARB has been very careful about, that when the market is working, sometimes it doesn't make sense to intervene, if you're going to come out with a similar result. And so I would sort of echo Severin's point of view. The biggest place we have market failure is in the cost of technologies. The cost of CCS is an important thing. I mean, you don't see any system's model about decarbonization that doesn't include a economical invention for carbon capture and sequestration right now is not actually on the market.

And if you -- if you've been like I have looking

at everything from the range of how do dealers sell or not sell electric vehicles to consumers to what products are on the market for consumers who are interested in electric vehicles, I would say that there's, you know, definitely a market failure there.

So I think that ARB, rather than creating distortions in the market, really needs to be, you know, doing things that assist with the decarbonization trend in a market-related way. You know, I think one of the great things about California is that we have an actually functioning carbon market, which is something that you can't say for some other places that have tried it. And to the extent that California's carbon market succeeds, it lays the groundwork for other places to continue to have carbon pricing, and even further to be a national carbon price.

So I would just emphasize that market solutions have proved to be pretty important in terms of setting a example for other parts of the world. And I would add to that, as Severin mentioned, you know, it's all well and good to have a market solution, but that doesn't give the right for companies to pollute. And I think that it's not ARB, but whether it's BLM or whoever the agencies are, DOGGR, really needs to be forced to go back and consider what our environmental rules are for the oil industry.

CHIEF ECONOMIST WIMBERGER: Great. Thank you. Go to Roger.

DR. AINES: I'd like to see California pursue policies that don't just meet our current plan, but exceed it, just like we just beat our 2020 plan already. That made me feel pretty good. I bet it made all you feel pretty good too. And if we can go faster, it's cheaper, and we have more options. Everything looks better. And so, you know, I think that adding policies that are going to on us -- give us more ways to do the things that we want to do - this is the same technology discussion that we just heard - I think are going to make a lot of sense.

My personal pitch is that carbon capture and storage is a policy by which the state's oil industry could reduce their own emissions and give us an opportunity to reduce -- diffuse emissions from a lot of sources, which is big problem. The most important thing is it's an opportunity that the state would have very strong control over. It could set the terms. It could set the standards. And then the state would be assured of a good outcome from that policy.

DR. BORENSTEIN: So I just want to go back to the fact that California is setting a model. We're one percent of world greenhouse gases. What we're really doing, not just on the technology side, but also on the

administrative side is we're creating models.

I had an opportunity to speak with a woman who is the head of Oregon's LCFS office. She told me that she actually is Oregon's LCFS office. That they essentially cut and pasted California's LCFS program, and made a couple minor changes.

That's what states do. They don't have the analytic capability that California has. They don't -- they're not as big and they are not as invested as we are. So I think every time we go down a road, whether it's with cap and trade, or LCFS, or direct regulations, or new technology investments, we are setting a model.

Many of you in the room and certainly on the panel have been in conferences with people from other countries. Chinese delegations come here very, very frequently to talk about our cap-and-trade market.

So we are setting a model not just for other states, but for the world. For that reason, I think we need to be really focused on experimenting and finding solutions that are exportable, not ones that are high cost and therefore aren't going to be adopted, or are very idiosyncratic and aren't really something that's got a general application.

That means knowledge creation that can really be exported. I don't know how well Roger's CCS technology

works. I'm always enthralled when technologists start talking about their solution and get very excited.

I don't know about Roger's. Many of them have disappointed me in the longer run, but that's okay. We should be investing in those, and we should be doing that in a smart way that makes the best possible use of limited resources, which means not only thinking hard about how we invest, but also thinking carefully about when we stop investing in a technology and say this just isn't going to get us there.

And if we do that, I think California can make a very big and important contribution to reducing world greenhouse gas emissions.

CHIEF ECONOMIST WIMBERGER: Thank you very much. That was a nice caps down.

So we're going to take -- this is the end of the second panel. I do want to thank all of the panelists for coming. This was a great discussion, and I agree we could have gone for much longer.

But we're going to take a bit of a break and come back at 3:30. And there will be time for public comment. Can I see a show of hands for how many people are anticipating making a comment?

(Hands raised.)

CHIEF ECONOMIST WIMBERGER: Okay. We might have

to enact a time limit. So I just wanted to take a survey. All right. So a little bit of a break. We'll be back at 3:30 for public comment.

Thank you, everyone.

(Thereupon a recess was taken.)

CHIEF ECONOMIST WIMBERGER: All right. We're going to get started. Hello.

All right. We're starting public comment. Take a seat, please.

All right. We're almost done. Okay. So we are going to have about 30 minutes of public comment. And while there will not be a response to the public comment, we are going to be transcribing the public comments, and we will be, you know, summarizing them in a white paper, which we will be developing that summarizes today's discussion.

In addition, there is a comment docket online, if you'd like to submit additional comments, and again, that is through Friday August 24th. We welcome comments via web as well.

So I do have a timer. And given that we have sort of limited time, I'm going to keep you to two minutes. I apologize. You can feel free to speak as quickly as possible. But we'll get going.

So -- and please announce yourself when you're

making you comment. Thank you.

MS. REHEIS-BOYD: Cathy Reheis-Boyd representing Western States Petroleum Association. That's the major oil and natural gas producers and refiners in the state.

So thanks for having us. I think we all know that California's growing economy and its population require all of us, you as policymakers, the academics that we heard from, the economists, we as industry leaders, that we really collectively work towards building as vibrant an energy future as we can together. And that does really, in our mind, involve balancing environment, economy, and equality.

So I want to make three or four quick points. One, Californians really need affordable and reliable transportation to commute, and to perform the jobs that support their families and build our economy. And as you know, we use a lot of gasoline and diesel and oil every day. We use 48 million gallons of transportation fuels, which includes gasoline and diesel an additional ten million gallons of diesel. We're the third largest consumer in the world behind the United States and China. So this is an important conversation.

We also have a huge energy deficit. We meet California's energy needs by using all, all of the oil that we produce here in the state. Plus, as you heard, we

import 70 percent. And so that is more than 56 percent from foreign sources that frankly they're from foreign countries that don't apply California's safety, labor, human rights, and environmental standards.

We also know that 92 percent of all of our transportation fuels come from the oil and gas industry and petroleum. And in the United States, that's 80 percent of the nation's energy comes from fossil fuels when you look out to 2050. So we have to remember that this is a very important industry to meet these obligations from an energy standpoint.

And I'd also just like to note that as an industry, we represent the brightest minds that deal with some of the things that some of the speakers talked about, the technology and the innovation, and our ability to really meet the demands of the California consumers and the citizens in this state.

So we look forward to this partnership. We understand that this is a very important dialogue. And we have to remember that we will utilize all of the production in the state, and that we are importing 70 percent from places like Saudi Arabia, Ecuador, and Iraq and Venezuela, and other places that do not have the same environmental standards that California does.

So, thank you.

CHIEF ECONOMIST WIMBERGER: Great. Thank you. I'm sorry. You can tell I'm a timer newbie.

MR. TURNIPSEED: Thank you. My name is Michael Turnipseed. I'm the executive director of the Kern County Taxpayers Association. I came here today to discuss potential outcomes that could have a devastating effect on the Kern County's economy. Simply put, the oil and gas industry is critical backbone of Kern County's economy.

Forty thousand jobs. 20.6 percent of all the jobs in the country are from the oil industry. Average pay, $84,000, $3.8 billion in local payroll, and 14 billion state and local taxes. A healthy oil economy is needed for a robust California economy, and is critical to the economic well-being of Kern County residents.

Now, since I have a minute left, I'm going to comment on some of the things today.

Kodak came up today. Kodak, BlackBerry, and Blockbuster didn't fail by being regulated out of business. They were innovated out of business. There's a big difference. If people don't innovate, the economy will take its course. I talk about market failures for the Golden State. For seven decades, we could do no wrong. We built houses everywhere. And now people who want to afford affordable housing, not because they want to, but they have to drive two and three hours to work,

because that's where the jobs are. They didn't create the jobs, but they got the jobs, and they're supporting their family.

And a second regulation is in the large truck business, which didn't get much today. We have our new engine tiers and we're continually upgrading diesel engines to make them cleaner, where do the old dirty trucks go? They go out of state. And out-of-state trucking companies buy them, bring them into California to could hauling, fueling in Arizona and Nevada, not buying diesel. They buy dirty diesel, not clean diesel. Not buying tires. Not buying engines.

They do not support the California economy. And while we put trucking -- truckers -- certain trucking business out of business, it all went out of state.

Thank you very much.

MS. SEDGWICK: Good afternoon. I'm Shannon Sedgwick. I'm Senior Economist at the LAEDC Institute for Applied Economics. And we conducted an analysis of the economic contribution of the oil and gas industry in the state of California, so what the value is of having the industry here. And I just wanted to share some of the top-line findings.

We found that the oil and gas industry generates over 148 billion in economic output annually. And it

sustains over 368,000 total jobs with an associated labor income of 33 billion. So the industry's fiscal contribution is estimated to exceed 42 billion annually.

The workforce is ethically and racially diverse. And opportunities exist across the skill spectrum. So about 40 percent of the workers have a high school diploma or less, and 30 percent are middle skill workers with community college level training.

Finally, petroleum is used as an input of production in other industries, which are also vulnerable to changes in supply and in price, including manufacturing industries, trade and logistics, and agriculture all are major industries in California.

And we'll be submitting the report to the record.

Thank you.

MR. MAGAVERN: Hi. Bill Magavern with Coalition for Clean Air. Anybody who understands the nature of the climate crisis knows that we need to get off of fossil fuels. I didn't hear anybody speaking today disagree with that. Therefore, we need to plan for that phase-out. It's not going to happen overnight. And California, as a major producer, should be one of the leaders of that planning.

That planning needs to include a just transition. A just transition was a concept originated by Tony

Mazzocchi, who was a leader of the oil chemical and atomic workers, so he represented oil workers, and he wanted to give them and others a transition that worked for them and their families.

Also, what we need to do to meet this charge of opportunities for additional GHG reductions start with continuing to enforce our existing policies, that includes the very important clean car standards that under attack by the Trump administration, as well as some of the oil and auto companies. It includes enforcing the new methane regulation that we supported, as well as the whole other set of California policies.

And then we need to continue improving the -- our engines, so that they are more efficient and cleaner. That includes the kind of reform that Board Member Sperling talked about. It includes regulations on fleets. So I'm very much looking forward to next week's workshop on zero-emission fleets.

We also need to continue cleaning up our fuels. And I think we need to have policies that will keep high carbon dirty fuels out of California, and continue the transition to low carbon renewable fuels.

And finally, we've made the least progress on reducing vehicle miles traveled. So we need much better transportation policies that will align with our climate

and air quality policies, and allow people to get around, give them clean mobility that does hot rely on single occupant vehicles.

And finally, we do -- all of those things will not only have additional GHG reductions, but we'll finally have clean air in California.

Thanks.

MR. ALONZO: Good afternoon. My name is Nathan Alonzo. I'm the Vice President of Government Affairs for the Fresno Chamber of Commerce. Our organization has 1,200 members representing over 77,000 jobs in California's Central Valley. I'm here to speak about the sizable impact that the energy industry has on our region.

Energy not only powers our region, but it also provides nearly 50,000 well-paying jobs to our hard working neighbors throughout the valley.

With many of these employees being from a variety of educational backgrounds from high school graduates to first generation college graduates. These individuals now have an opportunity to earn a great living, doing meaningful work, while giving back to their communities in various ways.

We need to keep the energy of our economy strong. Our region and the state need affordable and accessible energy in order to power a growing population.

By doing this, we will continue to grow our economy, create more jobs, and add even more shine to our Golden State.

Thank you for this opportunity.

MS. DE LEON: Good afternoon. My name is Kaelyn De Leon. And I'm the Manager of Policy and Public Affairs for the Greater Bakersfield Chamber of Commerce. It's a business organization representing over 1,100 members, which collectively employ over 75,000 Californians. Indeed -- Bakersfield is based in Kern County where we quite literally power California. Our county produces both the most oil and the most renewable energy in the State.

Our region is walking the talk in terms of helping California meet its climate goals, which is why I'm here today to stress how important the energy industry is to our region. Indeed, our historical industries of ag oil have embraced an all-of-the-above approach to deploying renewables, adopting water-saving approaches, and implementing waste emission reductions.

In Kern County alone, California's oil and gas industry is a major employer, which provides over 40,000 jobs, brings 14 billion in economic contribution, 945 million in state and local tax revenue, and encompasses nearly 30 percent of the total share of jobs in our

county.

This industry allows its employees, including many millennials in Kern County just entering the workforce to work in a respected industry, make a good living, and support their families in a state that's already considered too unaffordable to live in.

The oil and gas industry is not just fueling Kern, but many counties across California, which cannot be ignored. It is a vital part in our economy and continues to work toward innovation, alongside renewables that allows Kern to continue to power the rest of the state.

Thank you for the opportunity to share our comments.

MR. MAKUSON: Good afternoon. I'm Richard Markuson on behalf of the Associated Builders and Contractors Central California Chapter.

Over the past five years, over 50,000 workers have received safety and construction training at the Associated Builders and Contractors of Central California. Many of these workers found extremely high-paying jobs with benefits in the petroleum industry. Many have better lives today because of their job in the oil and petroleum industry. And without these career opportunities, these workers would have to relocate outside of the Central Valley and possibly even California.

ABC members drill and maintain the wills -- wells and build the infrastructure necessary for California's energy production. The policy decisions that you will be making risk increased cost and even curtailment of energy production, which can drive these projects workers outside of California, and maybe even outside of the United States.

This keeps our skilled workers from being employed in their home communities, and risk these jobs and the economy.

Thank you.

CHIEF ECONOMIST WIMBERGER: Next.

MR. MURPHY: I guess I'm jumping in line.

Hi. Colin Murphy with NexGen California. First, I just wanted to thank you and your colleagues at ARB for putting on really good series of panels and presentations and turning into a very high level discussion.

I think we're at a very interesting time in California's climate policy, in that now we have 10 years or more of experience from our broader climate policy, including the measures we've taken to reduce the consumption of petroleum so far.

And I think that having that 10 years of experience allows us a couple of opportunities. One is to really make sure that we base the decisions we make for

the future on the best science and evidence we have. And we have the opportunity to use the evidence of the last decade to retroactively evaluate a lot of the models that we've used before, figure out which ones work and to improve our decision making. And that requires using science and evidence and letting that be the primary driver of policy more so than the narrow commercial interests.

I think in a similar vein, when we discuss the decarbonization of California's economy, and the reduction of petroleum, there have been a lot of people who point out that that is an important part of our economy, and this is certainly true. But it's a part of our economy that we've been doing well using less over the last decade. And there have been many claims made over the last decade of California's climate policy that's saying that our efforts to use less oil were going to cause economic collapse, and cause the refinery sector to collapse, and drive up the price of gasoline. And none of those predictions have ultimately come true.

California has grown faster than most U.S. states. We're a head of most U.S. states in job creation. So I think as we hear arguments that say that we have to choose between a healthy economy and a health environment, we need to carefully examine are they relying upon the

same logic, which has already proven itself to be in effective and not let those kind of arguments deter us from taking bold action to achieve the critically important climate goals that we're setting out for and that we're discussing today.

Thank you.

MS. DINA ARGÜELLO: Good afternoon. My name is Martha Dina Argüello. I'm the Executive Director of Physicians for Social Responsibility, and also the co-chair of Standing Together Against Neighborhood Drilling in Los Angeles.

And I just wonder who speaks for the people who live next to where this practice happens. I hear a lot of people concerned with this practice happening internationally, but no concern for the thousands -- 650,000 just in the City of Los Angeles alone who live within 2,500 feet of an active oil well. I've also not heard anyone really talk about the public health impacts of the extraction, production, and distribution and use of fossil fuels.

So I agree with my colleague Bill Magavern that we need to find a path off fossil fuels. I believe in innovation. Certainly communities, low-income communities and immigrant communities, will depend on that innovation for those jobs of the future. And also to not forget that

in the clean up, and refurbishing, and making these sites healthy, there is actually a lot more economic opportunity.

In Los Angeles, there's about 200 to 300 actual jobs at the well sites. And so we feel that there is a lot more opportunities for economic development in the clean up, and -- of those sites.

So -- and the last thing I was a little troubled by the lack of any environmental justice voice on the panels today. And so, given that the burdens of the fossil fuel economy and many of the burdens of the implementation of AB 32, and many others climate policies, those burdens have been -- fallen disproportionately on low income communities of color. We need to fix that at CARB and do a better job of incorporating the scientists that work in our communities, but also the community voices who live every day with the air pollution caused by these drill sites, and whose health is compromised every day.

Thank you.

MR. SARAGOSA: Good afternoon. Michael Saragosa on behalf of the Central Valley Latino Mayors and Elected Officials Coalition. We represent some of the poorest cities in California, farm workers, farm worker communities. They're still dealing with the economic

effects of the recession. We have double digit unemployment in still many of these cities.

And so as we move forward here, we understand the environmental concerns. Our constituents live these daily. We want this to be a process where we already have economic hardship, where we don't cause even worse hardship to these communities. We understand we want to be environmental advocates, and we are environmental advocates, but we want this process to be what has been outlined in AB -- AB 32 implementation program. We think that's the fair way to go. We think innovation will slowly catch up as well, and allow for that process to be done in a way that doesn't really hurt the communities that it's supposed to help.

And so we hope CARB takes these comments to heart and thinks about those communities that are still suffering from economic disadvantage.

Thank you.

MR. WEISKOPF: Hi. Good afternoon. Thank you. David Weiskopf for NextGen.

I'd like to respond specifically to a point that was made in the final panel by Professor Borenstein to strongly agree with the perspective that California can and should and has developed policies that can be exported and adopted by other jurisdictions. I think that it's

time for us to do that in the space of a transition away from fossil fuels as well.

For technologies, we've shown that you can go to high levels of renewables. We've shown that we can start to make progress on electric vehicle adoption.

As the world transitions to a low carbon economy globally, fossil fuel production declines will start to mirror the decline rates that we've seen in California in the last several years.

We have the opportunity now to plan ahead for what that continuing decline will look like, and how to have a vibrant economic transition that other jurisdictions can adopt as they start to see similar trends.

Thank you.

MS. MONETA NINIA: Good afternoon. My name is Amanda Moneta Ninia and I'm representative for Kern Citizens for Energy. I have taken time away from the office to travel here from Kern County, because Kern Citizens for Energy knows that the issue is critically important.

KCE was founded to support local energy production, and thousands of our citizens who bring that energy to our homes and businesses. Kern Citizens for Energy represents more than 10,000 individuals in Kern

County, as well as five incorporated cities, ten chamber of commerce, hundreds of small businesses, and representatives from the health care, education, nonprofit, and public safety organizations.

Oil and natural gas is a vital -- is vital to our lives and allows us for a modern way of living, provides over 40,000 jobs in Kern County alone, and enables Californians to travel throughout the state on a daily basis.

I am daughter of an immigrant. And our petroleum industry has afforded my family great jobs and opportunity to succeed in this country. My dad came over here to the United States from Mexico when he was 17 years old. He became a U.S. citizen, got an education, and started working in the industry when he was about 27 years old.

Fast forward to 25 years later, he is still in the industry. Those who work in our local petroleum industries do so in the most environmentally responsible way, and with a strong focus on safety and everyone involved.

On behalf of our thousands of members, I thank you for the time and the opportunity to comment on this issue.

Thank you.

MS. HERNANDEZ: Hi. My name is Lizette Hernandez

and I'm direct of Environment and Health Programs at PSR L.A., Physicians for Social Responsibility. I'm also from South Central. I live in the red CalEnviroScreen area. Also, a child of an immigrant family. And I helped create the Watts Clean Air and Energy Committee, which is one of the communities that is direly affected by asthma and toxic air throughout the L.A. basin.

I would like to speak for those community members that are desperately seeking jobs in the clean energy. And so if there was just an ounce of equivalent energy into figuring out how we can do a just transition into the clean energy industry and economy, I think we would be in a much better place. I'm concerned about all these thousands of workers who seem to perhaps have no plan once, you know, the oil industry is tapped out.

And I think that -- I think it's irresponsible of the industry to keep speaking on the same narrative, acting as if there won't be change coming.

Change will come, and it is important for our communities to lead the way, and in particular those communities that are most affected.

I also am concerned about the language that was used regarding transfer of wealth. I'm not sure what sort of wealth they're talking about. I'm not sure if that refers to trickle down economy. But there are many

communities out there that are not seeing the billions and billions of profits that are being, you know, basically hoarded by the oil industry.

So I think that we need to bring balance to this conversation. We've had many folks representing the oil industry. And I speak for those communities that cannot afford to be here and are not paid to be here.

Thank you very much.

CHIEF ECONOMIST WIMBERGER: Anyone else for public comment?

Last call.

Okay. Well, thank you, everyone, for coming. I'll speak a little bit about next steps. So as I stated earlier, we are going to summarize today's proceedings in a public white paper, including public comments and any comments that are submitted online.

Feel free to submit written comments through Friday. I know it's a tight turnaround. I apologize for that. But if you can, that would be great.

But thank you. It was a great discussion today. I really appreciate the interaction with the participants. The panelists, thank you so much. Those of you that are still here, this was great. And looking forward to following up with a white paper soon.

Thank you for coming.

(Thereupon the Air Resources Board workshop adjourned.)

C E R T I F I C A T E OF R E P O R T E R

I, JAMES F. PETERS, a Certified Shorthand Reporter of the State of California, do hereby certify:

That I am a disinterested person herein; that the foregoing California Air Resources Board workshop was reported in shorthand by me, James F. Peters, a Certified Shorthand Reporter of the State of California, and was thereafter transcribed, under my direction, by computer-assisted transcription;

I further certify that I am not of counsel or attorney for any of the parties to said workshop nor in any way interested in the outcome of said workshop.

IN WITNESS WHEREOF, I have hereunto set my hand this 4th day of September, 2018.

JAMES F. PETERS, CSR
Certified Shorthand Reporter
License No. 10063